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RECENT KNOWLEDGE CONCERNING YELLOW FEVER.

A Report prepared by the Yellow Fever Commission of the *Office International d'Hygiène publique*.*

I.—Clinical Diagnosis.

The difficulty of diagnosing yellow fever among the native inhabitants of a suspected area is emphasized by all recent observers. The highly virulent "Asibi" strain of the virus was obtained from an African patient who had only slight fever, headache and pain in the back, and whose urine contained only a trace of albumin on the second day of the attack and none later. The "French" strain was also obtained from a patient (a Syrian at Dakar) with a mild attack. BEEUWKES, BAUER and MAHAFFY,[1] during an inquiry into yellow fever endemicity in West Africa, proved by means of "protection tests" the existence of yellow fever in several large towns but were quite unsuccessful in identifying actual cases of the disease among the native population. They concluded that it is not possible at present to diagnose clinically the mild cases which, it is presumed, are constantly occurring among the indigenous inhabitants. One of the difficulties which they reported was that almost 100 per cent. of the native children harboured malaria parasites and over 50 per cent. were infected with schistosomiasis accompanied by albuminuria. Diseases accompanied by jaundice are also frequently confused with yellow fever, as happened at Guayaquil in 1918 and in the recent epidemic at Rio de Janeiro. In both places cases of Weil's disease were present along with, and were diagnosed as, yellow fever.[2] Moreover, as reported by BEEUWKES,

* The Report was presented to the Permanent Committee of the Office International d'Hygiène Publique by Lieut.-Colonel S. P. James, adviser on Tropical Diseases to the Ministry of Health, London, and President of the Commission. It was adopted by the Committee at its Plenary Session of October 22nd, 1932, and published in French in the *Bulletin Office International d'Hygiène publique*, Vol. 25, January, 1933.

[1] BEEUWKES (H.), BAUER (J. H.) & MAHAFFY (A. F.). *Amer. Jl. Trop. Med.* 1930. Vol. 10. pp. 305–333. [This *Bulletin*, 1931, Vol. 28, p. 283.]

[2] SAWYER (W. A.), KITCHEN (S. F.), FROBISHER, Jr. (M.) & LLOYD (Wray). *Jl. Experim. Med.* 1930. Vol. 51. pp. 493–517. [This *Bulletin*, 1930, Vol. 27, p. 487.]

WALCOTT and KUMM,[3] an unnamed disease associated with jaundice and with a symptomatology suggestive in some respects of yellow fever, is widespread in Nigeria and other parts of West Africa. Finally must be mentioned the difficulty which arises so frequently in distinguishing between yellow fever and malaria under its various forms.[4]

On the other hand the result of recent unpublished observations by Dr. BEEUWKES establishes the possibility of diagnosing yellow fever clinically in the native. He will shortly publish the clinical records of more than 100 cases of this kind.

At the Conference on Yellow Fever held at Dakar in 1928, it was proposed by Inspector-General LASNET[5] that during periods when it is suspected that cases of yellow fever are occurring but cannot be definitely identified, the term " prophylactic diagnosis " should be introduced and officially recognised.

It is particularly important to make use of this " prophylactic diagnosis " on each occasion that a sick person is found, in an endemic or epidemic region, suffering from fever accompanied by an early albuminuria.

II.—Laboratory Diagnosis.

It was discovered by STOKES, BAUER and HUDSON[6] in 1927–28 that blood from yellow fever patients in the first three days of the illness is capable of communicating the disease to *Macacus rhesus* inoculated with it and that the procedure enables a diagnosis of yellow fever to be made in very mild cases not recognizable clinically. As the blood retains its infectivity *in vitro* for many days, samples from suspected cases can be sent for diagnosis to a central laboratory situated in a region where the disease cannot spread. It was proposed by Dr. A. W. SELLARDS at the Conference on Yellow Fever held at Dakar in April, 1928, that Governments should make laboratory arrangements for this diagnostic service. Possible risks of spread from the laboratories concerned have caused some countries where yellow fever has never existed, but where the mosquito vector is abundant, to object to introducing this procedure which, moreover, is expensive and is not applicable after the fourth day of the attack. Discussions on the subject are reported in the Procès-Verbaux of the Sessions of the Committee of the Office International d'Hygiène Publique for October, 1929, pp. 92 and 228, May 1930, p. 117 and May 1931, pp. 53 and 88 and in a paper by Professor SCHÜFFNER[7] of Amsterdam. The Governments of India, the Dutch East Indies and the Belgian Congo have made regulations under which it is forbidden to introduce, or to work with, material containing, or suspected to contain, the virus of yellow fever in any form.

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[3] BEEUWKES (H.), WALCOTT (A. M.) & KUMM (H. W.). *Trans. Roy. Soc. Trop. Med. & Hyg.* 1931. Vol. 24. pp. 429–451. [This *Bulletin*, 1931, Vol. 28, p. 858.]

[4] JORGE (Ricardo). *Bull. Office Internat. d'Hyg. Publique.* 1931. Vol. 23. pp. 682–692. [This *Bulletin*, 1931, Vol. 28, p. 997.]

[5] LASNET. *African Conference on Yellow Fever (Dakar—April 1928).* p. 31. [This *Bulletin*, 1929, Vol. 26, p. 602.]

[6] STOKES (A.), BAUER (J. H.) & HUDSON (N. P.). *Amer. Jl. Trop. Med.* 1928. Vol. 8. pp. 103–164. [This *Bulletin*, 1928, Vol. 25, p. 538.]

[7] SCHÜFFNER (W.). *Klin. Woch.* 1932. Vol. 11. pp. 753–757. [This *Bulletin*, 1932, Vol. 29, p. 578.]

III.—Diagnosis after recovery from an attack by "the protection tests."

A laboratory test is now available by which it can be ascertained whether a person has had yellow fever in the past. It is based on the discovery[8] that the blood serum of persons who have suffered from yellow fever, however long ago or in however mild a form, possesses the property of protecting *Macacus rhesus* from the effects of inoculation with yellow fever virus. The dose of serum (5 cc.) is injected intraperitoneally into the monkey and four hours later the dose of virus (1 cc. of a 1 in 10 dilution of blood from an infected monkey at the onset of fever) is injected subcutaneously. Two animals are used in testing each specimen of serum against a uniform dose of virus, the results being interpreted as indicating clearly that a person has had yellow fever only when his serum protects both animals used for the test. The procedure is called "the protection tests in monkeys."

In July 1930 Dr. THEILER[9] of the Harvard Medical School announced the discovery that white mice can be infected with the yellow fever virus if the inoculation is done intracerebrally. The disease produced is not yellow fever, it is an encephalitis, but yellow fever of the usual type is again reproduced when monkeys are inoculated with the brain tissue of infected mice. Repeated passage of the virus through mice produces a "fixed virus" which kills all mice on the fifth day after intracerebral inoculation. Death is prevented when serum from a recovered yellow fever patient is injected into the brain along with the virus. This is called "the intracerebral protection test in mice."

With the object of making the test more sensitive SAWYER and LLOYD[10] modified it by injecting the virus into the peritoneal cavity and at the same time a mild irritant into the brain to localize the virus there. The irritant used is 0·03 cc. of a solution containing 2 per cent. starch and 0·9 per cent. sodium chloride; the virus is a 20 per cent. suspension (not centrifuged) of the brain tissue of infected mice. In employing the test for ascertaining whether persons have had yellow fever in the past, the mice are used in groups of six. The starch solution is injected intracranially and then the mixture of virus (0·2 cc.) and serum (0·4 cc) intraperitoneally. Observation is for 14 days. If the serum is from a true case of yellow fever all the mice should survive, while all the controls (without serum) should die. This modified method is called "the intraperitoneal protection test in mice."

IV.—Reliability of the protection tests.

The reliance which can be placed on a positive result with the protection test as evidence that a person has suffered from yellow fever in the past has been enquired into by several workers, particularly HUGHES and SAWYER[11] and other representatives of the International Health Division working in New York and at Bahia in Brazil. The results of some of the tests conducted for that purpose in regions where

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[8] BEEUWKES, BAUER & MAHAFFY. See reference[1] on p. 265.

[9] THEILER (M.). *Ann. Trop. Med. & Parasit.* 1930. Vol. 24. No. 2. pp. 249–272. [This *Bulletin*, 1930, Vol. 27, p. 872.]

[10] SAWYER (W. A.) & LLOYD (Wray). *Jl. Experim. Med.* 1931. Vol. 54. pp. 533–555. [This *Bulletin*, 1932, Vol. 29, p. 198.]

[11] HUGHES (T. P.) & SAWYER (W. A.). *Jl. Amer. Med. Assoc.* 1932. Sept. 17. Vol. 99. pp. 978–981. [This *Bulletin*, 1933, Vol. 30, p. 2.]

yellow fever has never occurred are reported in the following section. HUGHES and SAWYER after discussing fully all possible causes of error in the intraperitoneal mouse protection test write as follows: "Although mistakes due to the presence of physiological protective substances or to the loss of specific antibodies with the passage of time, probably do occur in rare individual instances, and although other mistakes may arise through errors of technique, or the use of unsuitable animals, we are convinced that with reasonable care the test is remarkably specific and reliable, and that a positive result is strong evidence that the donor of the serum has previously been infected with the virus of yellow fever." Dr. F. F. RUSSELL, Director of the International Health Division, Rockefeller Foundation, in commenting on the subject for the information of the Yellow Fever Commission, writes as follows: "I can say that it is certainly not obligatory to conclude that any person whose blood serum showed any degree of protective power in the test with mice has previously been infected with yellow fever virus. Neither the test nor those who apply it are infallible. On the other hand, I consider a definite positive result very strong evidence in favour of previous infection with the virus. When groups of persons are studied, rare 'non-specific reactions' become of less importance and the tests give information of great value in epidemiological studies."

V.—Application of the protection tests for epidemiological studies.

In 1929 the Rockefeller Yellow Fever Commission in West Africa began to utilize the "monkey protection test" to secure information concerning the past distribution of yellow fever in that country. That test has since been largely replaced by the "intraperitoneal test in mice." This mouse test enables many more observations to be made and it is also claimed that it eliminates an error arising from the observation that occasionally, when using the monkey test, a monkey possessing a natural resistance to the yellow fever virus is among the test animals used. This cannot happen in the mouse test because it is the practice to use only particular strains of mice whose susceptibility to the virus is known.[12]

The purposes for which the test is applicable are stated by SAWYER and Wray LLOYD to be: (1) to determine whether yellow fever has been present in a region within the life of the present generation and to estimate the period at which the infection occurred and its extent; (2) to map large areas with regard to endemicity, epidemicity or absence of yellow fever and so to decide where control measures are necessary; (3) to identify the occurrence of yellow fever in areas where the disease is believed to be present but is seldom or never recognized; (4) to determine whether persons vaccinated against yellow fever by any proposed method have in fact been rendered immune.

An important practical application of the test at the present time is in connexion with endeavours to search out and define the latent endemic foci of yellow fever in areas through which aerial traffic may shortly be established. In October 1930, the Office International d'Hygiène Publique resolved to draw the attention of Governments to this important question and to request the Rockefeller Foundation to undertake the technical direction and organization of any enquiries

[12] SAWYER & LLOYD. See reference[10] on p. 267.

which might be initiated. On the 17th April 1931 a reply was received from the Foundation stating that every possible assistance would be given to the Office in connexion with the enquiries and offering (1) to train medical officers of the colonial services in the methods of performing protection tests ; (2) to examine in their laboratory at New York any specimens which colonial medical officers might collect. The President of the Office International d'Hygiène Publique brought these arrangements to the notice of interested Governments in a letter dated 18th June 1931. Effect is being given to them by several colonial Governments.

VI.—Protection test results.

By way of examples and without discussion of the conclusions to be drawn from them (which will be considered in the next section) the following is a brief record of the results of some protection tests :

Africa.

The first investigations by means of the protection tests were made in Nigeria and in Sierra Leone by the Yellow Fever Commission of the Rockefeller Foundation in West Africa. The examples which follow are given only to show the varying rates obtained in different parts of the country more or less affected by yellow fever.

Beeuwkes, Bauer and Mahaffy[13] of the Rockefeller Yellow Fever Commission in West Africa summarized as shown in the table the results which they obtained, employing the monkey protection test, in the first survey in Africa in 1929.

Towns	Total number of specimens tested	Number of sera which protected both animals	Number of sera which showed no protection	Number of sera with which only one animal died
1. *South-western Nigeria.*				
Ibadan	100	32	50	18
Ilorin	25	6	10	9
Total	125	38	60	27
2. *Northern Nigeria.*				
Bauchi	36	—	35	1
Zaria	29	—	27	2
Kano	25	1	21	3
Total	90	1	83	6
3. Ife, after an epidemic of yellow fever ...	25	17	6	2
4. Freetown. No yellow fever reported since 1910	34	1	30	3

In Ibadan (protection index 32 per cent.) four clinical cases of yellow fever were observed in 1925, but in Ilorin (protection index 25 per cent.) yellow fever had never been reported. In Ife (protection index 68 per cent.) there was an epidemic in 1928, eighteen cases being observed. Bauchi, Zaria and Kano were selected as representing localities where

[13] Beeuwkes, Bauer & Mahaffy. See reference[1] on p. 265.

a condition of endemicity could be definitely excluded. The results (protection index 0 in Bauchi and Zaria, 4 in Kano) were strikingly different from those of towns in what was presumed to be the endemic area. In Freetown, where epidemics of yellow fever used to be frequent, no clinical case had been observed since 1910 and the low protection index (3 per cent.) indicated that there is now very little, if any, risk of infection there. The contrast between recent and past history of yellow fever in this place was regarded as a striking demonstration of the value of piped water-supply and other sanitary measures in the control of the disease.

A few of the results of further tests by the same workers in Nigeria were reported in a paper by Dr. JOHNSON[14], the Director of Medical Services, in 1932, as follows: Kaduna township 2 per cent.; neighbouring pagan villages 83 per cent.; Hausa villages 29 per cent.; Gumel, a town on the northern border, 60 per cent. among adults, 44 per cent. among children; Sokoto, a town in the north-west, 0 per cent.

Since then many other results of protection tests in Nigeria have become available and it is considered that the enquiry in this country is almost finished. Dr. BEEUWKES is now engaged in analysing all these results and in preparing a map showing their distribution. He hopes to be able to determine from the analysis the value of the test in determining the incidence of yellow fever in Nigeria and will place his studies at the disposal of the Yellow Fever Commission.

Similar investigations have been commenced and are now being conducted in the Gold Coast, and in different French Colonies, *e.g.*, Senegal, Soudan, Haute Volta, the Ivory Coast, Guinea and Dahomey. It is hoped shortly to extend the enquiries to French Equatorial Africa, the Belgian Congo, and Angola.

Central America.

Panama[15].—Col. J. F. SILER, Chief Health Officer, Panama Canal Zone and Dr. L. B. BATES collected serum from 96 persons of ages ranging from 5 years to 85 years. The sera were tested in the Rockefeller Yellow Fever Laboratory, New York. Of 55 sera from persons under 29 years of age 52 gave no protection and the result in the remaining 3 was inconclusive. Of 41 sera from persons between 30 and 85 years of age 14 gave complete protection, 25 gave no protection and the result in the remaining 2 was inconclusive. Thus all the sera which gave protection were from persons old enough to have been infected before 1905 when the last known clinical case was observed.

North America.[15]

Negroes residing in Maryland.—Of 61 sera collected from adults, 57 gave no protection and the results in 4 were inconclusive. On a retest, two gave no protection, one was reported as inconclusive, the other as unsatisfactory.

Canada.[15]

Of 122 sera from persons who had either never been out of Canada or had not visited a country where yellow fever existed, all except three gave no protection. Of these three, one gave protection in two of seven tests; each of the others gave protection in one of 5 or 6 successive tests.

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[14] JOHNSON (W. B.). *Brit. Med. Jl.* 1932. Aug. 13. pp. 285–288. [This *Bulletin*, 1933, Vol. 30, p. 1.]

Brazil.[15]

Representatives of the Rockefeller International Health Division in Brazil made a series of protection tests on the sera of persons residing in places which were believed never to have been infected with yellow fever. Of 105 sera from Friburgo 93 gave no protection and the result with the remaining 12 was inconclusive. All of 135 sera from Guape were without protective power.

China.[15]

HUGHES and SAWYER collected sera from 103 adult Chinese of Peiping and tested them in New York. No specimen gave protection.

British India.[15]

Sera from 92 Tamil and Telegu natives of Southern India were collected by Col. H. H. KING, I.M.S. and Major W. J. WEBSTER, I.M.S. and were examined at the Rockefeller Yellow Fever Laboratory in New York. No protection at all was given by 87 of the specimens but the remaining five seemed to show some protective power with one or other of the two tests. Two of these sera protected in both tests and in the second in a dilution of 1 in 10. The ages of these persons were respectively 40 years and 17 years. Their cases are to be studied further if it can be confirmed that they have never been outside India.

VII.—General inferences which it is justifiable to draw from the results of protection tests.

In the opinion of most workers, the reliability of the protection test as evidence of antecedent yellow fever is no longer in doubt, but sufficient information is not yet available for a complete statement of the epidemiological inferences which it is justifiable to draw from available results in different regions. It is plain, of course, that no difficulty arises in interpreting the results of examples such as those relating to China, Canada, North America and some regions in Brazil recorded in the preceding section; clearly the meaning is that yellow fever has not occurred in those regions within the history of the present generation. Also there can be no question that the results of the test in Panama and in Freetown mean that the risk of yellow fever infection disappeared from Panama about 27 years ago and from Freetown about 20 years ago. But it is not so easy to interpret results from regions where the question for decision is whether the disease is constantly present in endemic form, or occurs only as intermittent epidemics. Dr. RUSSELL has stated the difficulty clearly in informing the Yellow Fever Commission that "a recent epidemic in a highly susceptible community, or two or three epidemics at rather long intervals, might give the same percentage of immunes as would be caused if the infection were constantly present in a community large enough to permit the disease to persist continuously." Epidemiologically and for the purposes of control and prevention it is important to know whether localities are in the former or in the latter category. The problem has arisen in respect of various localities in Nigeria where protection test surveys on a large scale have recently given positive results in localities widely separated from one another and with widely differing climatic conditions. It

[15] Communication to the Office International d'Hygiène Publique by Dr. F. F. RUSSELL, Director, International Health Division, Rockefeller Foundation, New York, U.S.A. See also HUGHES & SAWYER, reference[11] on p. 267.

would be incorrect to class all these localities as " endemic foci " or to consider that there is, necessarily, a risk of contracting yellow fever in them. What has next to be done is to supplement the indication of past infection afforded by the results of the protection test survey by intensive local enquiry into the several factors on which permanent endemicity depends. Perhaps, as Dr. RUSSELL has hinted in his informative and highly valued letter to the Commission, it may be the case that the " *veritable endemic foci* " *of yellow fever are fewer and more circumscribed than is sometimes supposed, but that the centres liable to the occurrence of epidemics of brief duration are more numerous and cover a wider geographical range. It is desirable that the difference should be emphasized in order to correct the alarm caused by loose statements indicating without qualification, that yellow fever is exceedingly widely distributed in West Africa.*"

Information is not yet sufficient for a decision on the significance which should be attached to occasional positive results of the protection test in individuals who, so far as is known, have not had yellow fever or have not resided in an area where the disease occurs. The two instances among the 92 specimens of serum from Tamil and Telegu natives of Southern India have already been mentioned. It was considered that the protective power of the sera of these two persons was too high to justify their classification in the category of " false positives " due to the rare physiological property possessed by some sera of showing a weak natural protective power. Further enquiry is to be made into these cases and tests are to be performed with the sera of persons from the same region who have had dengue and other diseases. The same will be done if occasional instances of " non-specific immunity " are discovered during the course of protection test surveys in East Africa. It is understood that Prof. SNYDERS[16] of Amsterdam has in train a series of protective tests with the sera of persons who voluntarily submitted themselves to infection with dengue fever for the purposes of the test. An important contribution to this question was recently reported by Dr. STEPHANOPOULO to the first International Congress of Mediterranean Hygiene at Marseilles. Employing the intracerebral protection test with mice he found the serum of 11 persons who were known to have had dengue in the course of the recent epidemic in Greece possessed no protecting power against yellow fever. Moreover Dr. BEEUWKES employing the intraperitoneal test with mice obtained the same negative result with the sera of 24 persons collected by Dr. BALFOUR at Athens, who had had dengue during the above-mentioned epidemic.

VIII.—Relative susceptibility of different races.

Some individuals suffer very lightly from yellow fever, others very severely. This applies to Europeans as well as to the indigenous inhabitants of epidemic areas, but apparently not to the same extent. In the course of protection test surveys it happens only very rarely that a European is found whose serum has a high protective power without any history or recollection of a previous illness suggestive of yellow fever. West African negroes, on the other hand, although they are susceptible to infection and sometimes show characteristic symptoms, rarely die from the disease and seem as a general rule to

[16] Communicated by Prof. W. SCHÜFFNER. *Brit. Med. Jl.* 1932. Aug. 13. p. 325.

have it in so mild a form that clinically it is not recognizable.[17] It has been suggested that possibly cases not recognizable clinically may be a general rule among other races of mankind, and it has been asked whether, for example, any clinical case of yellow fever has been known to occur in a native of British India resident in Africa. Probably the number of natives of India who have been exposed to the infection of yellow fever in Africa is too few to render a negative reply significant, but it is certain that Indians residing in other parts of the world where yellow fever occurs have contracted this disease. There is evidence of this in a report by Dr. P. C. FLU[18] on observations made during the 1908–9 epidemic of yellow fever in Paramaribo (Dutch Guiana) as well as in a publication by Daniel BLAIR on Yellow Fever in British Guiana.[19] On the general question of relative racial susceptibility Dr. RUSSELL has kindly collected the following information and opinions :

(1) Dr. Henry G. CARTER,[20] on p. 270 of his monograph on yellow fever published in 1931 says : " The African negro contracts yellow fever, so far as we know, as readily as other races, but has it more mildly and rarely dies of it.* His reaction to yellow fever is just what one would expect to have been evolved in a race for many generations subject to that infection, No other known race shows this reaction—certainly not the American Indian."

(2) It has been noted repeatedly that the Indians of Central Africa and Mexico, of Ecuador and of Peru, are just as susceptible to the disease, and that they have it in just as severe a form, as the white races.

(3) Colonel Joseph F. SILER, Chief Health Officer, Panama Canal Zone, has ascertained that among 21 deaths of Chinese employees of the French Company recorded in 1887, one was stated to be due to yellow fever; it is thought that 1887 was the only year in which the French Company employed Chinese labourers. From an examination of the records for 1904–5 among Canal Zone employees under the American administration, Col. Siler found descriptions of 6 cases of yellow fever (with one death) among Japanese labourers and mess stewards. The Diagnostic Board confirmed the diagnosis in each case.

(4) In a statistical report on yellow fever in the Province of Pacasmayo in Peru during 1921 seven cases of the disease among Japanese with three deaths are described.

(5) A report has been received of a fatal case of yellow fever in a Chinaman from Para, Brazil, on March 6th 1929. The clinical history and post-mortem findings were characteristic.

Dr. RUSSELL expressed the opinion that, although these examples are few in number, the evidence is sufficient to conclude that Japanese and Chinese contract yellow fever and die from it in about the same proportion as European races. There is thus no race which can be considered to be less liable to yellow fever than another. Observations made during the recent epidemic in Rio de Janeiro, however, have

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* Nevertheless, according to a report by Professor Ricardo JORGE[21] it was observed in the Belgian Congo during the epidemic of 1927–8 that the mortality among the natives attacked was as high as that of the European cases.

17 DUPONT. *Rev. Méd. et Hyg. Trop.* 1928. May–June. Vol. 20. pp. 65–79. [This *Bulletin*, 1928, Vol. 25, p. 844.]

18 FLU (P. C.). *Zeitsch. f. Hyg.* 1909. Vol. 65. pp. 17–54.

19 BLAIR (Daniel). Report on the first 18 months of the 4th Yellow Fever Epidemic in British Guiana (1856).

20 CARTER (H. R.). The Early History of Yellow Fever. 1931. Baltimore : Williams & Wilkins Co. [This *Bulletin*, 1932, Vol. 29, p. 245.]

indicated that in South America black races are attacked much less frequently than white races. Further research on this question is desirable.[21]

IX.—" Residential Immunity " (Immunité de Séjour).

It is a common belief that Europeans who reside a long time in an epidemic area of yellow fever become relatively free from the likelihood of contracting the disease. Observations on the belief are contradictory, but it has been proved by BEEUWKES and others that the failure to become infected (" immunity ") (if it exists) is not due to the presence of antibodies in the blood, for examinations by the protection test of sera from 25 persons who resided on an average 17 years in Nigeria showed that none possessed any protecting power.

X.—The use of vaccines and sera.

Workers in several countries have endeavoured to apply to yellow fever one or other of the four methods of immunization which has been tried more or less successfully in other virus diseases, namely :—

(1) Inoculation with immune serum ;
(2) Inoculation with a vaccine containing killed or attenuated serum ;
(3) Inoculation with a mixture of virus and immune serum ;
(4) Inoculation with a biologically modified virus.

The injection of convalescent serum from a recovered case of yellow fever protects against the result of an infection but the duration of protection is not thought to exceed three weeks or a month. Little or no success has been obtained with vaccines containing killed or attenuated virus and at present the inoculation which seems likely to give the best results is one comprising the simultaneous injection of a biologically modified mouse-virus strain and immune serum. FINDLAY and HINDLE[22] and other investigators were successful in producing a lasting immunity in monkeys by the simultaneous injection of immune serum and living virus, but the risk of accidental injections of laboratory workers with the virulent strains of virus maintained in monkeys led to the substitution, for immunizing purposes, of the less dangerous strain which was established in mice by THEILER. This is a biologically modified type of the " French " strain which after 100 successive passages through mice has lost its power to kill monkeys on subcutaneous inoculation. SAWYER, KITCHEN and Wray LLOYD[23] report that the vaccine is prepared in two parts : (1) A 10 per cent. suspension of mouse-brain tissue containing the virus is prepared in fresh, sterile, human immune serum and is tested for sterility and centrifuged. The supernatant fluid is passed through Seitz or Berkefeld N filters, collected in tubes, each containing 1 cc., and dried in the frozen state. (2) Immune serum is obtained from persons recently recovered from yellow fever and 0·2 per cent. of tricresol is added to the pooled serum

[21] JORGE (R.). *Bull. Office Internat. d'Hyg. Publique.* 1930. Vol. 22. pp. 1481–1493. [This *Bulletin*, 1931, Vol. 28, p. 281.]

[22] FINDLAY (G. M.) & HINDLE (E.). *British Med. Jl.* 1931. May 2. pp. 740–742. [This *Bulletin*, 1932, Vol. 29, p. 201.]

[23] SAWYER (W. A.), KITCHEN (S. F.) & LLOYD (Wray). *Proc. Soc. Experim. Biol. & Med.* 1931. Vol. 29. pp. 62–64. [This *Bulletin*, 1932, Vol. 29, p. 572.]

from several persons. For use, the dried serum is dissolved and brought to the original volume (1 cc.) with distilled water. The amount injected is 0·03 cc. per kilogram of body weight. In practice the immune serum is injected subcutaneously in two different places in the abdominal wall and immediately afterwards the dissolved vaccine is injected in the same way. The amount of immune serum injected (including the small part which is in the vaccine) is 0·3 cc. per kilogram of body weight. Protective power against yellow fever virus appeared in the serum of one vaccinated person on the seventh day, in 2 on the ninth day, in 6 between the twelfth and fourteenth day and in 1 on the twenty-first day. On the invitation of the International Health Division, Rockefeller Foundation, the British Colonial Office has recently deputed Dr. G. M. FINDLAY to study the mode of preparation of this vaccine and its practical application in the Yellow Fever Laboratory, New York.

XI.—Prevention and Control.

The work now being conducted at the Yellow Fever Laboratory of the Rockefeller Foundation, New York, with a view to the production of a prophylactic vaccine which will confer a lasting immunity on inoculated persons seems to foreshadow a highly important event in the history of yellow fever research. The procedure now being tested has been already mentioned in section X as being devised by SAWYER, KITCHEN and Wray LLOYD. It is being applied experimentally for the protection of laboratory personnel and field workers exposed to yellow fever infection[24] and it is understood that the next step may be the vaccination of European members of the Colonial Civil and Military Services whose duties take them to countries where there is a risk of contracting the disease. A practical application which would do more than anything else to allay existing fears of the risk of spread of yellow fever by aerial traffic would be to require the vaccination of all aircraft crews and of passengers from infected areas to uninfected (but infectible) areas. There may be difficulties in preparing sufficient quantities of the vaccine for general use in endemic centres because one of the ingredients is human serum from recovered cases of yellow fever, but effective vaccination applied even on a small scale would materially assist the natural cessation of epidemic spread which comes about as, CARTER showed many years ago, by " failure of the human host."[25] Every person who becomes immune as a result of an attack of the disease remains for the rest of his life incapable of having an attack and incapable of helping to spread infection. The duration of immunity produced by the new method of vaccination is not yet known.

Besides the prospect of obtaining an effective prophylactic vaccine, recent research has added greatly to the means at disposal for the control and prevention of yellow fever. In particular there is no longer any reason or excuse to neglect to notify cases, on the ground of differences of opinion about diagnosis of the kind reported in detail by Sir Rubert BOYCE in his book on yellow fever published in 1911. It can now be decided definitely by laboratory methods whether an illness of doubtful nature is due to yellow fever or not and if a positive result is obtained by the application of the procedure to one or two suspicious cases at

[24] SAWYER (W. A.). *Southern Med. Jl.* 1932. Vol. 25. pp. 291–296.

[25] CARTER (H. R.). *Public Health Repts.* Washington. 1914. Sept. 11. Supplement No. 19. p. 14.

the beginning of an outbreak, quick and complete notification of all subsequent cases would follow as a matter of course. The precision with which, by the application of the protection test, areas subject to yellow fever can be ascertained and their limits defined, is also noteworthy in relation to the control of the disease and to its avoidance when new routes through a country are being planned. In West Africa the results of " protection test surveys " have shown, not, as was formerly believed, that throughout the country the native is as saturated with yellow fever as with malaria,[26] but that there are areas where the disease has never existed, others where it existed formerly but has been entirely absent for ten or more years, and that even where the disease is constantly present in endemic form, or occurs intermittently in epidemic form, by no means all the inhabitants become infected. If positive results of protection tests are followed by up intensive local investigation and appropriate action, a great step will have been taken in reducing the present geographical distribution of the disease. For it can be said of yellow fever, as it cannot be said of malaria or of plague or of any other insect-borne disease, that if there is adequate knowledge of where and when the disease occurs there is little or no difficulty in getting rid of it. With precise information on this matter yellow fever is easier to control than is any other infectious disease, as was emphasized by several experienced sanitarians at the discussion on the subject held during the Centenary Meeting of the British Medical Association in July 1932.[27] It is important to recognize in this connexion that although on theoretical grounds some of the new knowledge acquired by study of the experimental disease in susceptible animals and mosquitoes seems to indicate that the risks of spread and the difficulties of control may be greater than was known, none of the fundamental observations which constitute the basis of successful public health action has been disturbed. During the last thirty years it has been repeatedly proved in practice that control and elimination can be successfully and speedily accomplished if action is taken in accordance with the basic observations that yellow fever is transmitted only from actual human cases in the first three days of the attack, that the incubation period of new cases does not exceed six days, that the agent of transmission is a domestic mosquito which remains in, or in the immediate vicinity of, the house where it has fed, and that the insect, after feeding upon an infected case must survive for twelve days or more before it can transmit the virus to another person.[28] A good deal has been written lately about the wide " range of dispersal " and power of flight of the yellow fever mosquito as estimated by field experiments[29] under artificial conditions, but for the purposes of practical sanitation it is more important to know that yellow fever has never been conveyed by mosquitoes many yards from an infected house. The late Senior Surgeon H. R. CARTER, whose epidemiological experience of yellow fever was unrivalled, wrote on this point : " I think it is fair to say that yellow fever will rarely be conveyed by mosquitos 100 yards. Surgeon WHITE would put the limit far below this, but I believe that it is quite frequently conveyed by mosquitos across the

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[26] BOYCE (Rubert). Yellow Fever and Its Prevention. 1911.

[27] *British Med. Jl.* 1932. Aug. 13. p. 324.

[28] Communicated by Dr. ORENSTEIN. *Brit. Med. Jl.* 1932. Aug. 13. p. 325.

[29] SHANNON (R. C.) & DAVIS (N. C.). *Amer. Jl. Trop. Med.* 1930. Mar. Vol. 10. pp. 151–156.

street or to a house at the back of the infected house. There are two cases, one reported by MELIER, the other by myself, in which it seems to have been conveyed much farther : in the first, 225 metres, in the second, 152 yards. Possibly we were both mistaken and there were some other means of infection than those we accused. Seventy-five yards would be about as far as one would expect it to be conveyed."[30] Occasionally to recall in this manner the views of sanitarians who were actually engaged in dealing successfully with serious epidemics is a useful corrective to the modern tendency to require that measures for prevention and control should be devised to cover all possible risks indicated by recent laboratory results.

It has been said that the yellow fever chapter of the *International Sanitary Convention for Aerial Navigation* is a concession to that alarmist point of view. Because our own Yellow Fever Commission was responsible for enunciating the principles on which this code of rules is based, we need not hesitate to admit that, short of forbidding aerial navigation entirely, no stricter rules could be prescribed. Sanitarians who, twenty years ago, had the task of preventing the spread of yellow fever from Panama and other infected ports, have said that the rules exceed the needs of the case. This may be true, but it is evidence that the provisions accord with the Permanent Committee's decision that in this International Convention, as in no other, sanitary safeguards must overrule all other considerations.

Novel departures from precedent are (1) that signatory countries where yellow fever may exist will not rest content to await the appearance of typical cases but agree to take steps for searching out unrecognizable cases of the disease by biological methods and, if it is present, for defining its geographical distribution ; (2) that measures for preventing spread by aerial traffic shall be taken primarily before departure from areas where the disease exists and only secondarily at ports of arrival. Measures to be taken before departure include the requirement that crews and passengers shall have been free from any risk of infection during six days before embarkation and that the aircraft and cargo shall be free from the possibility of conveying mosquitoes. Equally unprecedented is the concession that countries which are not infected but are infectible may refuse to permit the entry of aircraft from infected countries provided that they report the reasons for the prohibition.

In view of the ease with which aerodromes can be kept free from yellow fever mosquitoes by measures not involving drainage or clearing of streams, swamps and ditches, as well as the rapidity with which aircraft can be cleared of these insects by spraying or other simple means, the practical risk of conveying infection by aerial navigation is concerned almost solely with the human case in the incubation period of the disease. Article 42 of the Sanitary Convention for Aerial Navigation prescribes the effective measures against this risk. Moreover it it should be found that personnel and intending passengers can be effectively immunized against the disease, the fears of countries menaced by yellow fever will be greatly allayed and it will be practicable to dispense with some of the provisions of the Convention which at present may, on occasion, interfere seriously with speedy travel.

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[30] CARTER. See reference[30], p. 273.

YELLOW FEVER: SOME RECENT ADVANCES.*

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During the past few years very important advances have been made in our knowledge of yellow fever, mainly owing to the discovery by Stokes, Bauer & Hudson (1928) that the disease could be transmitted to monkeys (*Macacus rhesus* and *M. sinicus*). It was found that the disease could easily be maintained in these animals by the direct inoculation of infected blood or other tissues, or by the bites of infected mosquitoes, and the resulting possibility of laboratory investigations and detailed observations has been exploited to such a degree that more accurate knowledge has been obtained in all branches of the subject. In the present review attention is drawn to some of the more important recent advances, especially those of the last three years.

Distribution.

West Africa remains the most important endemic centre of the disease although there have been no very serious epidemics since the well-known outbreaks in Senegal and the Gold Coast in 1927. Nevertheless, isolated cases have been recorded each year and in 1931 there was a recrudescence of the disease in a number of scattered localities with no obvious connexion between them. During that year a total of 40 cases in Europeans was observed in six out of the nine French colonies in West Africa (*viz.*: Ivory Coast, Upper Volta, Soudan, Senegal, French Niger Territory, Mauritania), and in Togoland. Although the number of cases recorded was relatively small, a disquieting feature was their wide range, and especially the occurrence of cases as far inland as Garkidda, Nigeria, and Dosso, French Niger Territory (Boyé, 1932).

In South America, yellow fever reappeared during 1928 in Rio de Janeiro, with 125 recorded cases, 73 of them fatal. The following year a total of 613 cases were recorded, of whom 363 died (Fraga, 1930). Although no further cases have been recorded from Rio since 1929, there has been an increase in the prevalence of the disease in South America during recent years, cases having been recorded from various other parts of Brazil and from Bolivia and Colombia. During 1931, 34 cases were recorded occurring in 13 different and widely scattered localities, ranging from the State of Rio in the south to Ceara in the north, and inland to Palma (League of Nations' Report—1931). The lack of connexion between these cases strongly suggests that the disease may persist for long periods without being revealed by epidemic outbreaks.

* Dr. Hindle's article was completed at the time that the Report of the Yellow Fever Commission became available. Written from different standpoints they supplement rather than duplicate one another. It was therefore decided to publish them together.

Endemicity, with special reference to protection tests.

It is well known that the blood of persons who have recovered from yellow fever will protect both monkeys and mice (see below) against yellow fever, and by the use of protection tests with the sera of natives from various suspected localities attempts have been made to delimit the endemic areas of the disease. The most important experiments of this nature have been carried out in Nigeria, where Beeuwkes, Bauer & Mahaffy (1930) found that among sera collected at random from persons living in Ibadan and Ilorin 30·4 per cent. protected, and in Ife where an epidemic had recently occurred 68 per cent. of the sera (17 out of 25) gave protection. In Northern Nigeria, although earlier observations suggested the absence or rarity of the disease, later investigations have shown that even the dry northern regions are both infectible and able to maintain the infection throughout the year (see Johnson, 1932). Similar tests in French Niger and Dahomey gave 44 per cent. positive at Zinder among adults, negative in children; 48 per cent. positive at Tessaoua, and at Agadés all negative (Durieux, 1932). In South America protection tests or complement fixation tests have given similar results. Soper, Frobisher, Kerr & Davis (1932) found that approximately 42 per cent. of sera from Magé, Rio de Janeiro, were positive, as compared with only 3 per cent. from Piracicaba lying outside the yellow fever zone.

The results of these protection tests in both West Africa and South America show that a large percentage of the inhabitants of endemic areas acquire immunity without any apparent attack of the disease and the impression that yellow fever has almost disappeared from the world is shown to be far too optimistic. It is evident that only a very small percentage of the cases of yellow fever are recognized as such, and the endemic regions of West Africa and South America remain a potential danger to the health of countries containing the transmitting mosquitoes and the necessary climatic factors.

Methods of Transmission.

Direct transmission.—Apart from the usual method of infection by the bites of infected mosquitoes, it has been shown beyond any question, that it is possible to acquire yellow fever through handling infected material. Two hospital infections occurred in patients who acquired the disease, one in making blood slides and performing a white cell count and the other in doing routine biochemistry on a specimen of human infected blood. It is recommended, in consequence, that gloves should always be worn when taking blood specimens in endemic areas, whether yellow fever is suspected or not (Low & Fairley, 1931). The large number of cases of laboratory infections, at least 35 in the last few years (see Berry & Kitchen, 1931) is another indication of the highly infectious nature of yellow fever virus, for in the great majority of these cases there is no definite evidence of the method of infection, beyond the possibility of contact with the blood or other tissues of infected monkeys.

Transmission by mosquitoes.—The incubation period elapsing before a mosquito becomes infective has been shown to depend mainly on the temperature (Hindle, 1930). Ability to infect may be acquired after 4 days at 37°C., whilst at 21°C. 18 days is needed. When kept at 18°C. they were not infective after 30 days, but became infective when kept an additional 6 days at 23·4°C. (Davis, 1932). When

TABLE 1.

Summarizing the results of yellow fever transmission experiments with various species of insects other than *Aëdes aegypti*.

Species of mosquito	Locality of mosquito	Number of days since meal of infectious blood	Biting or Injection	Results	Authority
Aëdes luteocephalus ...	W. Africa	15–53	Biting	Efficient carrier	Bauer, 1928
A. stokesi *	,,	18–33	,,	,,	,, ,,
A. apico-argenteus ...	,,	17–30	Both	Negative	,, ,,
A. vittatus	,,	11–39	,,	Positive	Philip, 1929
A. africanus	,,	12–21	,,	,,	,, ,,
A. simpsoni	,,	19–43	,,	,,	,, ,,
A. irritans	,,	"Adequate incubation period"	Injection	,,	,, 1930b
A. nigricephalus ...	,,	,,	,,	,,	,, ,,
A. punctocostalis ...	,,	,,	,,	,,	,, ,,
A. scapularis ** ...	Brazil	13–30	Both	,,	Davis & Shannon, 1929
A. serratus	,,	17–31	Injection	,,	,, ,,
A. taeniorhynchus ...	,,	16–23	Both	,,	,, 1929 & 1931a
A. fluviatilis	,,	15–19	,,	Efficient carrier	,, 1931a
A. terrens	,,	11–17	Injection	Positive	,, 1931b
A. fulvithorax ...	,,	12–20	,,	Negative	,, ,,
A. albopictus	Java	Various	Both	Positive but inefficient carrier	Dinger & Colleagues, 1929
Psorophora cingulata	Brazil	13–15	Injection	Positive	Davis & Shannon, 1931b
P. ferox	,,	20	,,	,,	,, ,,
Eretmopodites chrysogaster	W. Africa	16–24	Both	,,	Bauer, 1928
Trichoprosopon (Joblotia) digitata ...	Brazil	Various	Injection	Negative	Davis & Shannon, 1931b; Kumm & Frobisher, 1932
Culex sp.?	Brazil	15–27	Biting	Negative	Marchoux & Simond, 1906
C. fatigans ? *quinquefasciatus*	,,	20	,,	,,	,, ,,
C. quinquefasciatus ...	,,	Various	Both	Doubtful	Davis & Shannon, 1929 & 1931b
C. thalassius	W. Africa	27–49	,,	Positive	Kerr, 1932; Philip 1930b
Wyeomyia bromeliarum	Brazil	16–32	Injection	Negative	Davis & Shannon, 1931a
W. oblita	,,	14–18	,,	,,	,,
Limatus durhami ...	,,	15	,,	,,	,,
Mansonia fasciolata ...	,,	14–21	,,	Positive	,, 1931b
M. chrysonotum ...	,,	14–15	,,	,,	,,
M. albicosta	,,	15	,,	,,	,,
M. titillans	,,	14–30	,,	,,	Kumm & Frobisher, 1932

* Referred to as *Aëdes apicoannulatus* in the original paper.

** MARCHOUX and SIMOND (1906) record negative feeding experiments with *C. confirmatus*, a synonym of this species.

TABLE I—*continued.*

Species of mosquito	Locality of mosquito	Number of days since meal of infectious blood	Biting or Injection	Results	Authority
M. uniformis ...	W. Africa	15–24	Injection	Positive	Kerr, 1932
M. (Taeniorhynchus) africanus	W. Africa	16 or more (in biting experiments)	Both	,,	Philip, 1930a
Anopheles albitarsis ...	Brazil	12	,,	Negative	Davis & Shannon, 1931b
A. tarsimaculatus ...	,,	12–18	,,	,,	,, ,,
A. gambiae	W. Africa	1–4	,,	Positive	Philip, 1930a
Cimex lectularius ...	Brazil	2–12	,,	Faeces infective	Monteiro, 1929
C. hemipterus ...	,,	2	,,	Positive but negative after 2nd day	Kumm & Frobisher, 1932
Triatoma megista ...	,,	7	,,	Doubtful	Davis & Shannon, 1931a

kept at lower temperatures (10°C.–15°C.) the virus persists in mosquitoes without their bite becoming infective, but if these insects are subsequently kept at temperatures above 20°C. they become infective. A mosquito that has become infective retains its infectivity by bite even if kept at temperatures of 10°C.–15°C. (HINDLE, 1930). SCHÜFFNER, DINGER & SNIJDERS (1930) found that lowering of temperature seemed to have some effect on the infectivity of the virus in *Aëdes aegypti*, for some which had kept at 16°C. failed to produce any fatal infections when allowed to feed on monkeys, but all these animals proved to be immune when subsequently inoculated with infective virus. HINDLE also showed that the simultaneous ingestion of a mixture of yellow fever virus and immune serum failed to produce infection in mosquitoes, and yet these same mixtures were infective when inoculated into monkeys. These results explain why in yellow fever the blood usually ceases to be infective to mosquitoes whilst virus is still present in the circulation (HUDSON & PHILIP, 1929). The ingestion of immune serum, however, has no effect on the infection once it has become established in the mosquito (DINGER, SCHÜFFNER, SNIJDERS & SWELLENGREBEL, 1929; HINDLE, 1930; DAVIS, 1932).

Hereditary transmission of the infection to the offspring of infected mosquitoes seems to have been definitely excluded, for in spite of numerous experiments, using very large numbers of infected mosquitoes, no case of such transmission has been obtained, although many observers have investigated this question. Another possible method of the infection being maintained in mosquitoes in the absence of a susceptible vertebrate host was suggested by ARAGÃO and LIMA (1929), who found that when infected female mosquitoes were kept in contact with normal males, the latter became infected, as tested by the inoculation of an emulsion of their bodies into monkeys. KERR & HAYNE (1932) in a careful series of experiments entirely failed to obtain any

transmission of virus from infected females to males kept in contact with them, and HINDLE (1930) showed that Aragão's result could be explained by assuming that the males had been soiled by the faeces of the females which ARAGÃO & da Costa LIMA (1929) had shown to contain yellow fever virus. FROBISHER, DAVIS & SHANNON (1931) showed experimentally that a colony of infected mosquitoes ceased to become infective within 16 weeks, which is approximately the length of time an infected female would have lived. Although *Aëdes aegypti* is unquestionably the most important vector of yellow fever, the Oriental races from India and Java being as efficient carriers as the West African and American races (HINDLE, 1929; DINGER, SCHÜFFNER, SNIJDERS & SWELLENGREBEL, 1929), many other species of mosquitoes have been shown to be capable of transmitting the disease experimentally, or of harbouring the virus for varying periods. Table I comprises a list of the species of insects that have been tested for their capacity in this direction.

Immunity.

The persistence of immunity against this disease has been strikingly demonstrated by SAWYER (1931) who made protection tests with the sera of 60 persons who had had what was believed to be yellow fever between 30 and 78 years previously. The sera of 45 were protective, including 5 out of 6 sera from persons infected 75 years previously and one 78 years, so that ordinarily immunity seems to last for life. HINDLE (1932) trying to find some explanation for the long persistence of such a high degree of immunity, attempted without success to demonstrate residual virus in monkeys that had recovered from yellow fever. Although the inoculation of the tissues of recovered animals into normal monkeys failed to produce infection, those inoculated with liver or spleen developed a transient immunity, but the inoculation of kidney or brain had no effect. The protective value of immune serum is well known, but this passive immunity is of short duration and in the case of monkeys disappears within seven weeks even when a homologous serum is used; when a heterologous immune serum (human) is used, the immunity completely disappears within two weeks (BAUER, 1931b). In striking contrast with the short duration of passive immunity is the strong and lasting protection following the simultaneous injection of virus and immune serum and this method has been recommended by ARAGÃO (1931), and FINDLAY & HINDLE (1931) for the protection of human subjects. The practical difficulties in the application of this method have been largely overcome by the important discovery (THEILER, 1930) that after a few passages in the brains of mice, yellow fever virus loses to a great extent its power of producing a general infection in man or monkey. Consequently by the use of such "mouse virus" it is possible to inoculate human subjects with virus and immune serum without exposing them to the possible risks of fully virulent yellow fever virus, and yet the resulting protection seems to be comparable in strength with that following an attack of the disease. SAWYER, KITCHEN & LLOYD (1932) have elaborated this method of vaccination and recommend the injection of a dried mixture of living yellow fever virus, fixed for mice, and human immune serum, with separate injections of enough additional human serum to make up the amount required for protection. The amount of virus used is generally 0·003 gm. infected mouse brain per kilo body weight, and the total

amount of immune serum 0·3 cc. per kilo body weight. The only serious objection to the general use of this method of vaccination is the necessity of obtaining fairly large quantities of human immune serum. Possibly this might be overcome by the use of monkey immune serum or horse anti-yellow fever serum, such as that prepared by Pettit, Stefanopoulo & Frasey (1928), for Martin-Charpenel, Mathis & Kolochine (1932) have shown that both these sera neutralize the mouse virus. Sellards & Laigret (1932) have vaccinated a few patients with small doses of the brains of mice infected with yellow fever after 134 passages in mice. Doses of 1 : 1,000 to 1 : 10,000 of a mouse brain suspension inoculated subcutaneously failed to produce any reaction, but the inoculation was followed by the development of antibodies in the blood. The objection to the general use of this method, apart from any remote possibility of the virus suddenly acquiring virulence, is the fact that live virus would be present in the body of the patient and therefore presumably might be capable of infecting any susceptible mosquitoes that fed on him. The use of immune serum would seem to remove this risk without preventing the development of protective antibodies. For the present other methods of vaccination have been discontinued, for the use of virus exposed to the action of phenol or formaldehyde (Hindle, 1928) has been found to involve considerable practical difficulties. Although used with success in the South American epidemics (Aragão, 1928), later experiments (Okell, 1930) showed that the vaccine kept at ordinary ice-box temperatures soon lost its protective properties. Hindle (1929) showed that the vaccine could be dried without losing its properties and would then remain unchanged for some considerable period, but Sawyer, Kitchen & Lloyd (1932) found that it was very difficult to estimate the exact degree of exposure of the virus to attenuating agents, necessary to destroy virulence without affecting its antigenic properties.

Complement fixation.

Various attempts have been made to discover some simple test for yellow fever which would obviate the necessity of protective tests in experimental animals. Vellard & Vianna (1929) studied modifications of the blood and found there was a marked diminution in its coagulability, due to the appearance of antithrombin in the blood, the change exceeding that in any other disease observed by the authors. Da Costa Cruz (1929a) found a marked diminution in the amount of complement present in yellow fever patients to less than a quarter of the normal content. The alteration in the amount of complement was found to be due to a reduction of the albumin fraction, the globulin fraction being little affected (da Costa Cruz, 1930). During convalescence the amount of complement often was in excess of normal. Frobisher (1929) using a saline extract of infected liver and spleen of yellow fever monkeys as antigen, obtained fairly good results with the complement fixation test. Monteiro & Travassos (1930) also used this method with success. Davis (1931) used an antigen consisting of plasma or serum virus, obtained by collecting the blood of infected monkeys on the first or second day of fever. Although very definite results were obtained with infected monkeys this author obtained very inconstant results with human sera. The concentration of complement fixing bodies was found to reach its maximum in monkeys after 30 to 40 days

and they remained in the circulation for a few months to more than a year (FROBISHER, 1931a). A second injection restored their strength without producing fever (DAVIS, 1931). HUDSON (1931) found in five human cases of yellow fever that although protective antibodies appeared in the blood five days after the onset of fever, the complement fixation did not appear until after 8 weeks in four cases and remained negative in the fifth case. Various improvements have been suggested in the preparation of the antigen, especially the extraction of fat from the dried liver extract (FROBISHER, 1931a; HUDSON, 1932); but the results obtained by this test which has been used especially in Brazil (MONTEIRO & TRAVASSOS, 1930; SOPER, FROBISHER, KERR & DAVIS, 1932) only give an approximation to the actual number of cases, since complement fixing bodies are less constantly produced and are also less permanent than the protection bodies.

Protection tests.

The presence of active immune bodies in the blood of recovered yellow fever patients, furnishes an obvious method of testing the incidence of the disease in any particular locality. The earlier tests involved the use of monkeys and consequently could only be applied on a comparatively small scale. THEILER (1931) showed that by using yellow fever virus adapted to mice, tests could be made in these animals. SAWYER & LLOYD (1931) modified the original method of injecting the serum and virus intracerebrally, for it was found that if yellow fever virus fixed for mice, was inoculated intraperitoneally, and at the same time an intracerebral injection of 0·03 cc. of 2 per cent. corn starch in 0·9 per cent. sodium chloride, the virus became localized in the brain. The serum to be tested is mixed with the virus before being inoculated into the mice and if protective bodies are present no infection results. This intraperitoneal test in mice is highly sensitive, many sera which do not protect monkeys protecting mice; consequently it is of great value in epidemiological studies of the disease and also to test whether vaccinated persons have been fully immunized.

Non-specific immunity against yellow fever.

The absence of yellow fever from Oriental countries has sometimes been attributed to a supposed protection conferred by a previous attack of dengue fever. This hypothesis has recently received some support from an observation of DINGER (1931b) who inoculated 11 monkeys that had suffered from dengue 13 to 36 days previously, with virulent yellow fever material. Three of these monkeys died of typical yellow fever but the remaining eight were unaffected, although control monkeys showed a mortality exceeding 90 per cent. On the other hand, STEFANOPOULO & CALLINICOS (1932) made yellow fever protection tests in mice with the sera of 11 patients who had recovered from severe attacks of dengue in Greece, but none of the sera gave any protection; therefore the resistance of the recovered dengue monkeys to yellow fever would seem to require some other explanation.

Occasionally in mouse protection tests examples of non-specific immunity have been recorded, the sera of persons who could never have been exposed to yellow fever, in some unexplained manner

protecting experimental animals against infection. Thus HUGHES & SAWYER (1932) examined the sera of 109 Canadian residents by means of the intraperitoneal test in mice; one serum gave complete protection and five inconclusive results, the remainder being negative. Also two sera out of 53 collected at Madras gave definite protection (JOHNSON, 1932). The rarity of such cases, however, shows that they are so exceptional as in no way to invalidate the general results of epidemiological studies based on these protection tests.

Yellow fever in experimental animals.

Since the original demonstration of the susceptibility of *Macacus rhesus* to this disease a very large number of animals have been tested for their capacity of harbouring yellow fever virus. Many species of primates have been shown to be susceptible and in the majority of macaques and most South American monkeys the disease is very fatal, producing a type of infection resembling severe human cases. In other species on the other hand such as *Cercopithecus tantalus* the disease is only rarely fatal, but the virus can be recovered for some time after inoculation from the blood of the animal. Other species, such as the baboon, seem to be definitely resistant, but if inoculated with virus, their serum may develop anti-viral properties.

Table 2 summarizes the results of recent attempts to infect various species of animals with yellow fever.

TABLE 2.*

Summarizing the results of recent attempts to infect various species of animals with yellow fever.

Species of animal	Result of inoculation with virus	Authority
ORDER PRIMATES.		
Family Pongidae.		
Chimpanzee (probably *Pan satyrus*)	Resistant, but blood develops anti-viral properties	Stokes, Bauer & Hudson, 1928. Pettit & Aguessy, 1932.
Family Cercopithecidae.		
Cercopithecus mona	Resistant	Bauer & Mahaffy, 1930b
C. tantalus	Persistence of virus in blood with no obvious ill effects ...	,, ,,
C. griseo-viridis ... (= *C. aethiops*)	Resistant	Pettit & Stefanopoulo, 1929
C. callitrichus ... (= *C. sabaeus*)	,, ...	,, ,,
Erythrocebus patas ...	Persistence of virus in blood with no obvious ill effects ...	Bauer & Mahaffy, 1930b
Cercocebus torquatus	,, ,, ,,	,, ,,
Macacus rhesus ... (= *Macaca mulatta*)	Susceptible	Stokes, Bauer & Hudson, 1928.
M. sinicus ... ... (= *Macaca radiata*)	,, ...	,, ,,
M. cynomolgus ... (= *Macaca irus*)	,, ...	Aragão, 1928a.

* The names in brackets are those given by FLOWER in his list of mammals. [*List of the Vertebrate Animals exhibited in the Gardens of the Zoological Society of London*, 1828–1927. Vol. 1. Mammals. By Major S. S. FLOWER.]

TABLE 2—*continued.*

Species of animal	Result of inoculation with virus	Authority
M. speciosus ... (= *Macaca fuscata*)	Susceptible	Aragão, 1928b.
M. inuus ... ... (= *Macaca sylvana*)	,, ...	Pettit & Stefanopoulo, 1930.
M. nemestrinus ... (= *Macaca nemestrina*)	Slightly susceptible ...	Dinger, Schüffner, Snijders & Swellengrebel, 1930a.
Papio sphinx ... (= *Papio papio*)	Resistant, but blood develops antiviral properties	Pettit & Stefanopoulo, 1929.
Cynocephalus hamadryas ... ... (=*Papio hamadryas*)	,, ,, ,,	,, ,,
Family Cebidae.		
Aotus trivirgatus ... (= *Aotes trivirgatus*)	Slightly susceptible ...	Davis, 1931.
Callicebus moloch ...	,, ,, ...	,, ,,
Pithecia monacha ... (= *P. monachus*)	,, ,,	,, ,,
Cacajao rubicundis (= *C. rubicundus*)	Resistant	,, ,,
Saimiri sciurea ...	Susceptible	Kuczynski, 1929.
Cebus macrocephalus (= *C. fatuellus*)	Slightly susceptible ...	,, ,,
C. variegatus ... (= *C. xanthosternos*)	,, ,,	Davis, 1930a.
Lagothrix lagotricha (= *L. humboldtii*)	,, ,,	,, 1930b.
Ateles ater	Susceptible	,, ,,
Alouatta seniculus ...	,, ...	,, 1931.
Family Hapalidae.		
Callithrix jacchus ... (= *Hapale jacchus*)	Susceptible	Kuczynski, 1929.
C. albicollis ... ... (=*Hapale albicollis*)	,, but disease unlike human	Davis, 1930.
Leontocebus ursulus (= *Mystax ursulus*)	,, ,, ,,	,, ,,
ORDER CHIROPTERA.		
Molossus obscurus ...	Resistant	Kumm, 1932.
Desmodus rotundus	,, ...	,, ,,
ORDER CARNIVORA.		
Domestic Cat ...	Survival of virus in blood for at least 30 days	Monteiro, 1930.
Dog	Survival of virus in blood for a few days	,, ,,
ORDER RODENTIA.		
Guineapig ... ... (*Cavia porcellus*)	Modified infection ...	Kuczynski & Hohenadel, 1930. Dinger, Schüffner & Snijders, 1930.

Yellow fever virus in mice.

In addition to the ordinary "septicaemic" type of yellow fever, THEILER (1930) has produced a "neurotropic" strain by the intracerebral inoculation of the virus into mice. These animals are resistant

to the intraperitoneal injection of ordinary virus, such as that occurring in the blood of cases of yellow fever in man or monkeys, but if this virus is introduced intracerebrally some of the mice become ill and die with symptoms of encephalitis. If this virus is propagated in mice by brain to brain inoculations, after a few generations it acquires definite neurotropic characters and if inoculated subcutaneously into a monkey or man no longer produces any obvious signs of infection. Nevertheless, in spite of the absence of any symptoms of yellow fever, the blood of these subjects develops antibodies against this disease, equal in intensity to those developed after recovery from an attack of typical yellow fever. These results have been confirmed by DINGER (1931), SELLARDS (1931) and others, and now form the basis of immunization against yellow fever by the use of living virus and immune serum (see above p. 282).

The neurotropic virus is capable of reverting to the ordinary septicaemic type after only a few passages in mice, and DINGER (1931a) found that mosquitoes fed on a serum suspension of the brains of infected mice, at the 10th to the 12th passage, became infective and produced typical yellow fever when fed on monkeys. DAVIS, LLOYD & FROBISHER (1932) found that when the virus had been passaged in mice for longer periods the neurotropic character became fixed and even when the virus was ingested by mosquitoes remained unaltered. By the bites of these mosquitoes encephalitis was produced both in white mice and rhesus monkeys.

SELLARDS (1931) showed that when monkeys were inoculated intracerebrally with the neurotropic mouse virus, they regularly developed a fatal encephalitis but without any characteristic changes in the liver, and four passages in monkeys by direct inoculation from brain to brain failed to restore the original properties of the virus. Two monkeys, however, inoculated intracerebrally with blood virus died of typical yellow fever with necrosis of the liver but no signs of encephalitis. Similar results have been obtained by LLOYD & PENNA (1932) and demonstrate the fixed nature of the neurotropic virus, which differs fundamentally from the parent strain.

Pathology.

Intranuclear inclusions.—The most notable recent advance in this subject has been made by TORRES (1928 *et seq.*) who in a series of papers called attention to the importance of the so-called oxychromatic degeneration of the liver cells in yellow fever, resulting in the development of characteristic acidophile inclusion bodies within the nuclei, of the same general type as those produced in certain other virus infections, such as herpes zoster, varicella, virus III of rabbits, etc. These inclusion bodies have also been studied in detail by COWDRY & KITCHEN (1930). With the exception of a few very rare cases, in which some of the suprarenal cells showed the bodies, they are restricted to the liver cells. Although almost constantly present in monkeys dying of yellow fever, they have not been found with the same regularity in human cases of the disease. TORRES (1929) examined 12 fatal cases of the disease in Brazil with negative results, and HOFFMANN (1929) found them in only one—a West African—out of a large number of cases. KLOTZ & BELT (1930) found inclusion bodies in 38 per cent. of human African cases and in only 9·2 per cent. of American, but the tissues of the latter group were not so well fixed. Later observations, summarized by TORRES (1931),

support the view that the presence of these bodies may be correlated with the existence of virus, for they have been found in rapidly fatal human cases of the disease whose tissues presumably would still be infective. Moreover they disappear very rapidly in recovered monkeys. Snijders & Dinger (1931), however, consider that the intranuclear bodies represent specific degenerative changes produced in the course of the disease. In monkeys and mice infected with the neurotropic strain of yellow fever Theiler (1930) & Goodpasture (1932) have found intranuclear inclusions in the ganglion cells of some of the infected animals.

The *general pathological changes* in the spleen, liver and kidneys of yellow fever cases have been studied in detail by Klotz & Belt (1930) who found that there was no significant difference between African and American cases. In every case of recovery complete and scarless regeneration occurred. Magalhaes (1931) has described the changes in the kidney and Lloyd (1931) the changes in the myocardium of yellow fever in monkeys and man. Penna & de Figueiredo (1930) consider that the presence of the so-called Councilman necrosis of the liver cells is the most certain method of diagnosing human cases of yellow fever.

Kuczynski with Hohenadel (1929) in a series of publications advanced the view that an organism named *Bacillus hepatodystrophicans* is the causative organism of yellow fever. Manteufel & Herzberg (1930) found that this bacillus was identical with *Bacterium renale cuniculi*, an organism often present in the kidneys of apparently normal rabbits, and also found that media containing fresh kidney tissue might show no signs of infection until after 20 days incubation period. Da Costa Cruz (1929b) considered the bacillus akin to *Corynebacterium lymphophilium*, and Dinger, Schüffner & Snijders (1931) also considered that it was a diphtheroid.

Miscellaneous observations.

Cultivation of virus.—Haagen & Theiler (1932) have cultivated the virus of yellow fever, pathogenic for mice, in a medium consisting of minced chicken embryos suspended in a mixture of normal monkey serum and Tyrode solution, and incubated at 37°C. The virus seems to be capable of being grown indefinitely by making subcultures every three or four days and has been tested up to the 22nd subculture without showing any diminution in virulence.

Chemistry and Metabolism.—The chemistry and metabolism of experimental yellow fever has been studied in a series of papers by Wakeman & Morrell (1931, 1932), their results supporting the view that all the metabolic changes can be interpreted as resulting from a loss of liver function, there being no definite evidence of serious impairment of kidney function. They also confirmed Kuczynski & Hohenadel's (1929) observations as to the extreme hypoglycaemia occurring towards the end of infection.

Findlay & Hindle (1930) showed that one of the toxins developed in yellow fever is a guanidine-like substance, the quantity of which increases in the blood of infected monkeys up to more than double the amount present in normal monkeys. Injections of calcium lactate were found to reduce the guanidine base content of the blood, and also if given at four-hourly intervals prevented haemorrhages. Even when combined with injections of dextrose, however, this treatment

failed to prevent the final collapse and death of monkeys infected with yellow fever, but it may be of use in preventing haemorrhages.

Properties of virus.—Sellards & Hindle (1928) showed that the virus could be preserved in the frozen state and Hindle (see Fowler, 1928) also proved that it retained its properties indefinitely if dried *in vacuo*. Sawyer, Lloyd & Kitchen (1929) found that it was best to freeze the infected material before drying *in vacuo*. Virus kept in 50 per cent. glycerine remained potent for at least 60 days when stored in the refrigerator, but after 100 days gradually lost its virulence. Pettit, Stefanopoulo & Kolochine (1929) recommend the use of Vallé's glycerine phosphate mixture for preserving infected liver or blood in the refrigerator. Frobisher (1930) noted some of the properties of the virus, which differs from bacteria in its power to withstand the action of such disinfectants as mercuric chloride 1 in 7,500, phenol 1 in 150, etc., for 30 minutes at 30°C. Serum virus was completely inactivated when heated at 60°C. for 10 minutes. Dried blood virus was still infective after a similar exposure. The size of yellow fever virus particles has not yet been accurately determined, but it is well known that the virus will pass through ordinary porcelain filters. Sawyer & Frobisher (1929) showed that although the virus in the mosquito, if suspended in salt solution, is arrested by Berkefeld filters V and N, yet the addition of an equal volume of normal monkey serum, makes it filterable. Consequently the virus in the mosquito does not differ from the virus in the blood with regard to filtration. Bauer & Mahaffy (1930a) showed that the virus would pass through filters as fine as Chamberland L 11 candles without showing any marked diminution in concentration, which in the blood of infected monkeys may contain as much as 1,000,000,000 lethal doses per cc. (Bauer, 1931a). Saline was found to have a very deleterious effect on the virus which died out within 6 hours or less in such suspensions, but if 10 per cent. serum was added this effect was very much reduced.

Hindle & Findlay (1930) using Bedson & Bland's method found that the virus of yellow fever is negatively charged at pH ranging from 5·2 to 7·0 and is destroyed in acid media of pH 3·0 to 4·0. Frobisher (1931b) using a U-tube apparatus obtained similar results and found that between pH 7·4 and 6·2, the virus passes through its isoelectric range and then tends to reverse the direction of its migration, thus behaving like an amphoteric colloid. In slightly alkaline dilutions antibodies were found to carry a negative charge.

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(Except where otherwise stated, references are given only to abstracts of the papers in the *Tropical Diseases Bulletin*. Dates in brackets are those of the original papers and do not always correspond with the date of the *Bulletin* containing the abstract.)

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MEDICAL ENTOMOLOGY.

BUXTON (Patrick A.). **The Effect of Climatic Conditions upon Populations of Insects.**—*Trans. Roy. Soc. Trop. Med. & Hyg.* 1933. Jan. 31. Vol. 26. No. 4. pp. 325–356. With 5 figs. [63 refs.]

This paper is a review on the relation of insects to climate, and must be read in full if the whole argument is to be appreciated. The numbers of insects are altered by many different causes, the most important being climate and an increase or decrease of their enemies and parasites. Seasonal changes in the insect population may be correlated with the incidence of certain diseases, such as the relation between rat fleas (*Xenopsylla cheopis*) and plague in rats and men in tropical countries, and between lice and relapsing fever in Northern India. Similarly, excess of winter rain in Mediterranean countries is followed by a great increase in the numbers of Anopheles and by outbreaks of malaria. The factors at work in these cases may be investigated either in the field or in the laboratory. Field observations are a necessary preliminary, but their function is largely to set problems which can subsequently be solved only in the laboratory, where experiments can be devised in which single factors vary; the most important factors being temperature and humidity.

It is generally found that insects die after one hour at 104°F. to 113°F., or after an exposure of 24 hours between 95°F. and 104°F. In many parts of the Tropics the shade temperature exceeds these limits, and this is probably why insects become rare at particular seasons. On the other hand, while in warm climates many insects exist at temperatures approximating to the fatal, they can survive temperatures many degrees below what they encounter in nature. Temperature factors often operate at critical points in the life cycle, but so far as insects of medical importance are concerned, in no species have these critical points been determined. Furthermore, apart from its *lethal* effect, temperature very largely determines the *velocity* of insect development.

So far as the factor of humidity is concerned, insects may be divided into two classes—water "spenders" and water "savers." The former live in moist environments, eat food of high water-content, and lose water readily in their excretion, etc. The latter class live in dry environments on dry food, and are resistant to starvation. The tsetse fly (Glossina) is obviously a "spender," depending on high atmospheric humidity; the adults of Lucilia, Calliphora and Musca, and the larva of *X. cheopis*, also come into this category. On the other hand, the tick, *Ornithodorus moubata*, the adult *X. cheopis*, and the bugs Cimex and Rhodnius, are "savers." In hot dry air a large insect may or may not regulate its body temperature by evaporation, but it can be proved by calculation that a small insect cannot do this, and it depends for its existence on having a high thermal death point and on being a water "saver." In many insects, both in the egg and adult stages, the rate of loss of water and consequently the duration of life of the fasting insect is determined (within certain limits) by saturation deficiency. This generalization may prove of value in forecasting changes in insect populations; but it is most important to study this and other climatic factors affecting insects in the actual situations in which the insect lives

(the " micro-climate ") which may be very different from the climate recorded by the meteorologist. It is possible that to change the micro-climate may prove the simplest method of eliminating certain insect pests. *V. B. Wigglesworth.*

Buxton (Patrick A.). **Terrestrial Insects and the Humidity of the Environment.**—Reprinted from *Biol. Reviews.* 1932. Oct. Vol. 7. No. 4. pp. 275–320. With 4 figs. [6 pages of refs.]

This is a comprehensive review of the present state of knowledge on the relations of terrestrial insects to water. The aim of the work is to interpret ecological observations on insects in terms of physiology, and it deals with the following topics : (i) gain of water : by drinking and feeding, from metabolism, and by absorption from the atmosphere ; (ii) loss of water : by excretion and by evaporation ; (iii) water balance : dealing with the water content and its regulation ; and (iv) the influence of humidity on the egg stage, in causing dormancy and such like. Insects of medical importance figure frequently in the course of the argument. There is a bibliography including more than 250 titles. *V. B. Wigglesworth.*

Dunn (Lawrence H.). **An Effective Method for Collecting Ectoparasites from Live Animals and Birds.**—Reprinted from *Psyche.* 1932. Vol. 39. Nos. 1–2. pp. 26–29.

Animals such as opossums, monkeys, squirrels or peccaries, and also birds, are readily freed from lice and fleas by the following procedure. The legs are tied together and the animal placed in a large glass jar with the head exposed ; the jar is closed above by a towel wrapped round the animal's neck ; and chloroform is then applied to the towel. Most of the ectoparasites fall to the bottom of the jar ; the remainder are combed out of the animal's fur.

V. B. Wigglesworth.

Hoffman (W. A.). **Recent Progress in Medical Entomology.**—*Bol. Asoc. Med. de Puerto Rico.* 1932. Nov. Vol. 24. No. 206. pp. 650–662. [57 refs.]

A very readable report of a lecture dealing with advances during the last five years. The chief subjects treated are yellow fever and the typhus group of diseases (Brill's disease, Mexican typhus, Marseilles fever and Rocky Mountain spotted fever). Shorter sections recall recent work on Oroya fever, the transmission of filarial worms by blood-sucking insects and the use of blow-fly larvae in the treatment of chronic osteomyelitis. *V. B. Wigglesworth.*

Schwetz (J.). Notes géographiques d'entomologie médicale sur la province Orientale (Congo Belge). (Tiques, Tabanides et " Maringoins." [**Geographical Notes on Medical Entomology in the Eastern Province of Belgian Congo (Ticks, Tabanids and " Midges ")**.]—*Ann. Soc. Belge de Méd. Trop.* 1932. Dec. 30. Vol. 12. No. 4. pp. 549–555.

The lists and notes of which this paper consists are offered as a contribution to a more or less complete study of the distribution of the various blood-sucking insects and ticks found in the spacious

Eastern Province of Belgian Congo. Such a study, however, is a matter for the distant future, and must be based on the painstaking work of a number of observers. The collections now recorded were made at Stanleyville and elsewhere in the Eastern Province, from 1927 to 1929. Mosquitoes, tsetse flies and the genus *Phlebotomus*, which have been dealt with by the author in previous papers, are not included. "Maringoins" (freely rendered above as "midges") is the term bestowed in Belgian Congo upon small blood-sucking Diptera of various genera—Culicoides and Simulium, as well as Phlebotomus. As regards Simulium, Schwetz thinks that *S. neavei* may be concerned, as is *S. damnosum*, in the transmission of onchocerciasis. *E. E. Austen.*

Beattie (Mary V. F.). **The Physico-Chemical Factors of Water in Relation to Mosquito Breeding in Trinidad.**—*Bull. Entom. Res.* 1932. Dec. Vol. 23. Pt. 4. pp. 477–496. With 11 figs. & 2 plates. [15 refs.]

In continuation of the physico-chemical studies, carried out by her some years ago, of the factors which possibly control the selection by mosquitoes of breeding-places near London, the author worked in Trinidad, B.W.I., from June 1929 until April 1931. In this island *Anopheles tarsimaculatus*, a species remarkable for its catholicity of choice in the matter of breeding-places, was found to be the prevalent Anopheline, and it was accordingly decided to limit the investigation, the results of which proved mainly negative, to an analysis of the waters upon which its eggs are deposited. In Trinidad, the larvae of *A. tarsimaculatus* are met with "indiscriminately in fresh or saline waters, having been found in ground pools, small pools in meadows, the edges of marshes, railway borrow-pits, dirty irrigation canals and rice-fields." With regard to the *hydrogen ion concentration* and CO_2 contents in the case of six "potential breeding-places" (ponds) selected by the author for analysis, the conclusion, supported by tables and figures, is that "no definite correlation exists between the reaction of the water and the prevalence of *A. tarsimaculatus*." Neither did the total *organic nitrogen* nor the *dissolved oxygen*, "alone or in combination," appear to have any influence on the prevalence of *A. tarsimaculatus* in any of the ponds; *nitrites and nitrates* also showed no correlation with Anopheline prevalence; *phosphates* (not present in any great quantity in any of the ponds examined) "had no apparent effect on Anopheline breeding." The *chloride* content in all but one of the ponds was extremely low, but "increase in salinity did not influence the prevalence of *A. tarsimaculatus*"; and "no correlation was found between the amount of total solids present in the ponds, and the prevalence of Anophelines."

The prevalence of *A. tarsimaculatus* larvae in the ponds appeared, however, to vary inversely with the amount of *ammonia nitrogen* in the water; but since, in the laboratory, larvae were found to thrive in water "with an ammonia nitrogen content of 0·1 to 0·2 parts per 100,000," the author suggests that it may be oviposition that is affected by this factor. Subsequent investigation of rice-field and canal waters confirmed this hypothesis, while in the laboratory *A. tarsimaculatus* larvae lived for several days in rice-field waters containing as much as 0·12 parts of ammonia nitrogen per 100,000. Thus, from data collected during the first year of the investigation,

ammonia nitrogen seemed to be the only factor in any way correlated with larval incidence. The author, who in the first year had investigated breeding-places of a general character, therefore decided, owing to the evolution of nitrogen gas in the soil of rice-fields, and the importance of the latter as Anopheles breeding-grounds in the tropics, in the second year to analyse the waters of rice-fields and irrigation-canals. During the first year *A. tarsimaculatus* larvae had appeared to be more abundant in the canals than in the rice-fields, where they became very rare when the crop was more than a foot in height. Six rice-field stations were selected for study, and analysis of field- and canal-waters was begun in June 1930. Here also the physico-chemical conditions appeared to have no effect upon mosquito-breeding. " No correlation was found between the incidence of *A. tarsimaculatus* and the following factors : pH, carbon dioxide, organic nitrogen, dissolved oxygen, nitrites, nitrates and phosphates."

A summary is given of the results obtained by recent workers who, in various parts of the world, have studied the complex problem of the selection of breeding-places by mosquitoes. We are not much wiser than before, and since inhibiting factors conceivably vary with the species of mosquito, the problem needs to be solved for each species, a task of no small magnitude.

In continuation of research upon the breeding-place preferences of *Aëdes argenteus* (= *A. aegypti*) and *A. variegatus* initiated by Buxton & Hopkins in Samoa (1927), the author carried out two experiments with the former species, in the laboratory and in the field respectively. From the results it is inferred that water containing organic nitrogen in solution is preferred by the ovipositing yellow fever mosquito, and that the higher the organic nitrogen content the more attractive is the water. *E. E. A.*

Hoskins (W. M.). **Toxicity and Permeability. I. The Toxicity of Acid and Basic Solutions of Sodium Arsenite to Mosquito Pupae.**— *Jl. Econom. Entom.* 1932. Dec. Vol. 25. No. 6. pp. 1212–1224. With 3 figs. [32 refs.]

The contents of this highly technical paper cannot adequately be conveyed in the form of a summary, and the malariologist who is interested should consult the original. While anti-mosquito measures are of course directed mainly against larvae, Hoskins, whose work was done in California, employed pupae (of *Culex tarsalis*) as the subjects of his experiments, in order to eliminate the complication that would otherwise have been introduced by the pH of the contents of the larval intestine. The relative toxicity to the pupae of dilute acidified and of basic solutions of sodium arsenite was determined by means of the lengths of immersion needed to produce a mortality of 50 per cent. It was found that, over the range of concentration from 0·01 to 0·03 molar solutions, the toxic action of the acidified solutions is approximately 4½ times as rapid as that of the basic solutions. This is considered to be due to the ease with which tissues are penetrated by the arsenious acid molecules of the acid solutions, as compared with the difficulty experienced by the arsenite ions of the basic solutions in effecting similar penetration. It is to be noted that, while " the taking in of arsenic [by the mosquito pupa] is relatively rapid . . . . the toxic effect is exerted slowly." Thus, although 50 per cent. of the pupae died after exposure to arsenite

solutions lasting from 26·5 to 800 minutes according to concentration and pH, death itself did not occur until 2 or 3 days later. Analyses in order to determine the minimum lethal dose of arsenic, made in pupae which died after exposures of definite length, proved unsuccessful owing to the minuteness of the amounts involved. *E. E. A.*

Badenoch (A. G.). **Twelve Months Records of Mosquito-Breeding in Telok Anson with Special Reference to Hydrogen-Ion Concentration.**—*Malayan Med. Jl.* 1932. Sept. Vol. 7. No. 3. pp. 82–87, & 90. With 1 graph. [11 refs.]

The hydrogen-ion concentration of the natural waters in this region (as determined by a rough colorimetric method) ranged from pH 4·0–8·5. The common species of Anopheles as well as the Culicine mosquitoes were found breeding throughout this range. But " though the actual range has been shown to be wide, the investigations left in [the author's] mind little doubt but that neutral and slightly alkaline waters are *favoured* by local Anophelines, in preference to acid waters." No actual figures are given to support this contention.

V. B. Wigglesworth.

i. Wigglesworth (V. B.). **The Adaptation of Mosquito Larvae to Salt Water.**—Reprinted from *Jl. Experim. Biol.* 1933. Jan. Vol. 10. No. 1. pp. 27–37. With 2 figs. [25 refs.]

ii. Villain (Georges). Note sur la présence de larves d'anophélines dans les eaux salées du Sahel Tunisien. (**Notes on the Presence of Anopheline Larvae in the Salt-Waters of Tunisien Sahel.**)—*Riv. di Malariologia.* 1932. May–June. Vol. 11. No. 3. pp. 346–352. [12 refs.] English summary (4 lines) p. 414.

i. The object of this contribution, which should be read in conjunction with two previous papers (" The Effect of Salts on the Anal Gills of the Mosquito Larva," and " The Function of the Anal Gills of the Mosquito Larva ") by its author in the same number, was to determine the nature of the physiological adaptation which enables the larvae of certain mosquitoes to flourish both in fresh and salt water, while the latter is rapidly fatal to the larvae of other species of mosquito.

As the subjects of his experiments, Wigglesworth employed larvae of the yellow-fever mosquito, *Aëdes argenteus* (= *A. aegypti*) ; although the larva of this species is unable to tolerate water possessing a high degree of salinity, " it is probable that the relatively small *degree* of resistance which it can acquire is of the same *kind* as that occurring in more tolerant species, and therefore the mechanism of this resistance may throw light upon the general problem." In place of ordinary sea water, the author used an artificial sea water of which the composition is given, and the osmotic pressure of which was about the same as that of 3·5 per cent. sodium chloride. The concentration of this " sea water " is expressed in terms of solutions of NaCl having the same osmotic pressure.

While there were considerable individual variations, fourth stage (final instar) larvae, reared in fresh water and transferred to sodium chloride solutions of various strengths at 74°C., were unaffected by solutions not exceeding 0·9 per cent., but in a 1·1 per cent. solution nearly all died in 4–7 days. " Sea water " proved to be less lethal

than pure sodium chloride, " 1·5 per cent." sea water having about the same degree of toxicity as 1·2 per cent. sodium chloride. In studying the effect of salts upon the growth of newly-hatched larvae, the latter were fed upon powdered Loeffler's serum, in order to eliminate the indirect influence on growth which salt water might otherwise have through its action upon the micro-organisms which form the natural food of the larvae. In concentrations of sodium chloride the growth of newly-hatched larvae is but very slightly retarded below 0·8 per cent., after which the inhibitory effect rapidly increases. Such larvae are killed by 1·1 per cent. NaCl., or by " sea water " equivalent to 1·3 per cent. NaCl. When the concentration was gradually increased larvae could be made resistant to 1·1 per cent. NaCl and to " sea water " equal to 1·75 per cent. NaCl (50 per cent. sea water). No obvious difference in appearance is to be noted between larvae habituated to 1 per cent. NaCl and those in fresh water; in " sea water " equivalent to 1·75 per cent. NaCl, on the other hand, larvae have a " shrunken appearance," which increases with the concentration. Further differences occur in the anal gills, which Wigglesworth, in the second of the two papers mentioned above, considers to be " primarily water-absorbing organs . . . . only incidentally concerned in respiration "). It is pointed out by the author in the " Discussion " forming the latter part of the paper under consideration that the larvae of certain species of mosquito can resist " far higher concentrations of salt " than those lethal to the subjects of his experiments. Thus R. Vogel, in 1927, recorded the finding of larvae of *Aëdes zammittii* " in pools of concentrated sea water with crusts of salt on the surface "; and during the War, near the eastern side of the Suez Canal, the present writer found both Anophelines (*A. multicolor*) and a Culicine breeding freely in water containing 8,716 parts of NaCl per 100,000.

When a larva accustomed to 1 per cent. NaCl was placed by Wigglesworth in tap water after its body had been ligatured just in front of the Malpighian tubes, excretion of fluid by the Malpighian tubes showed a great increase; small drops " were passed down the hind gut, on an average, every 2 min. for half an hour, and yet only three very small drops were discharged from the anus." There was no accumulation of fluid in the rectum, so that it was evident that it had been reabsorbed into the body, which became greatly swollen behind the ligature. The author suggests that " increased activity on the part of the rectum in reabsorbing fluid may be a factor both in the adaptation of the larva to salt water and in the excessive swelling which occurs when such larvae are ligatured and restored to fresh water." Larvae, however, display considerable individual variation in their response to this treatment. *Aëdes argenteus* larvae which had been deprived of their gills were not more resistant to salt water than larvae in which the anal gills were entire: this " serves to confirm the conclusion that these larvae are not killed by the osmotic pressure but by the toxic action of the salt water, acting probably by way of the intestine."

ii. In October, 1931, larvae of *Anopheles maculipennis* and *A. multicolor* were discovered—the latter for the first time in the Sahel—in saline water, destitute of plant life, in an irrigation drain at Bekalta. In the laboratory it was noticed that the larvae of *A. multicolor* were in the habit of remaining at the bottom of the receptacle in which they were kept, buried in fine silt. The water in the drain, the pH

of which was 8·4, contained 35·4 gm. of chlorides per litre; on November 8, owing to concentration due to evaporation, the chloride content of the sample of this water in which one of the *A. multicolor* larvae was still living was 41·6 gm. per litre. [Seawater contains approximately 30 gm. per litre.] This communication shows that in Tunis *A. multicolor* is not purely Saharian; the presence of *A. maculipennis* larvae where they were found is thought to be due to their having been washed out of their natural breeding places by rain. *E. E. A.*

Kalandadse (L.). Materialien zum Studium der Atmungsprozesse der Mückenlarven und -puppen und der Einwirkung von Petroleum, Beschattung und Verunreinigung des Wassers auf dieselben. [**Studies on the Respiration of Mosquito Larvae and Pupae and the Effect upon them of Petroleum, Shade and Dirty Water.**]—*Arch. f. Schiffs- u. Trop.-Hyg.* 1933. Feb. Vol. 37. No. 2. pp. 88–103. With 1 fig. [14 refs.]

Larvae of Culex, Stegomyia and Anopheles can survive submergence for several hours, the time of survival being greatest in Stegomyia. This is attributed [without evidence] to respiration through the anal gills. The mode of action of petroleum on larvae is discussed and the author's experiments favour the [now generally accepted] view that it serves as a contact poison acting through the tracheae. Larvae of *Anopheles maculipennis* developed more slowly in the dark; but the amount of shade provided by overhanging vegetation had no significant effect on the rate of growth. Contamination of the water with horse manure made it unfavourable for *A. maculipennis*, but did not prevent breeding entirely. *V. B. Wigglesworth.*

Marshall (J. F.) & Staley (J.). **On the Distribution of Air in the Oesophageal Diverticula and Intestine of Mosquitoes. Its Relation to Emergence, Feeding and Hypopygial Rotation.**—*Parasitology.* 1932. Oct. Vol. 24. No. 3. pp. 368–381. With 8 figs. [14 refs.]

Much uncertainty, reflected in a varying nomenclature, has hitherto prevailed with reference to the function of the oesophageal diverticula in mosquitoes. Working at the British Mosquito Control Institute, Hayling I., April–November, 1931, the authors, who dissected upwards of 800 mosquitoes both before and after emergence from the pupa, have shed a more precise light on the question.

The hatching of the adult mosquito is facilitated by the swallowing by the latter of air which accumulates under the pupal skin. This air passes directly to the stomach, causing expansion and thus helping to rupture the pupal envelope. Subsequently, within an hour after emergence of the imago has taken place, the air in the mid-gut begins to pass forward into the oesophageal diverticula, previously empty, and in 12–22 hours the mid-gut has ceased to contain air. The later behaviour of the oesophageal diverticula depends upon the nature of the food. When mosquitoes are fed on fluid other than blood (*e.g.* raisin juice), " the liquid goes direct into the oesophageal diverticula and [as found 30 years ago by Nuttall & Shipley] displaces the air more or less completely." When the insects suck blood, the latter passes " entirely (or almost entirely) " straight into the stomach. Air in the diverticula of " domestic " mosquitoes diminishes in amount before hibernation, but increases in quantity as the hibernating period

approaches its end. No confirmation was obtained for SCHAUDINN's view that lodgment of air in the diverticula is but temporary, and that the air is replaced by carbon dioxide resulting from the action of yeast cells contained in the sacs. In newly-emerged male mosquitoes, it was found that the rotation of the hypopygium through 180° and the expulsion of the air from the mid-gut into the oesophageal diverticula take place concurrently.

An interesting "Note on Mosquito Bites," from which it appears *inter alia* that those of two *Aëdes detritus*, subsequently "found to have a large number of yeast cells in their sacs," were not unusually irritating, is included in the paper. *E. E. A.*

HAMLYN-HARRIS (R.). **Some Further Observations on *Chara fragilis* in Relation to Mosquito Breeding in Queensland.**—*Ann. Trop. Med. & Parasit.* 1932. Dec. 16. Vol. 26. No. 4. pp. 519–524.

Although most investigators who have studied the subject consider that charophytes are of no value for the prevention of mosquito breeding, MATHESON & HINMAN, working with certain species of Characeae, obtained positive results and are therefore of the contrary opinion. Hamlyn-Harris is on the side of the majority, and contends that his experiments, some of which are described in this paper, "conclusively prove . . . . that *charophytes are of no value* in the biological control of mosquitoes in Queensland." While it frequently happens that mosquito larvae are absent from waters containing Chara, this may be due to a variety of causes with regard to which we are at present entirely ignorant. Using the two house mosquitoes of Queensland, *Stegomyia fasciata* (= *Aëdes aegypti*) and *Culex fatigans*, as well as the tree-hole breeder *Aëdes notoscriptus*, and affording them free access to "dozens of jars . . . . containing various types of aquatic vegetation . . . . at the same temperature and under similar conditions throughout," the insects, *mirabile dictu*, oviposited only in the jars in which there was *Chara fragilis*. The experiments lasted for months, during which the pH showed little variation; the respective control jars contained Hydrilla, Ceratophyllum, Valisneria and other aquatic plants; and the Chara (from horse troughs in which *Anopheles annulipes* had been found breeding) was either in various stages of vigorous growth, or decomposing. In the latter condition in one instance lasting for 8 months, the plant "imparted to the water a most unpleasant foetid smell, suggestive of garlic," yet *Aëdes aegypti* bred "specially freely" in this water. Among mosquito enemies in the jars were a fungoid growth (*Saprolegnia monica*), which proved fatal to young larvae of *Culex fatigans* whenever it attacked them; certain unspecified Coleopterous larvae; and a peculiarly voracious species of Hydra. *E. E. A.*

REICHSGESUNDHEITSAMT, Berlin. Die Mückenplage und ihre Bekämpfung. [**The Mosquito Nuisance and how to deal with it.**] 4th Edition.—40 pp. With 12 figs. & 1 coloured plate. 1932. Berlin: Verlag von Julius Springer.

In the 21 years that have elapsed since the appearance of the previous edition of this pamphlet, much new experience in mosquito-control has been gained, justifying the present edition, which has been prepared by Dr. VON SCHUCKMANN. Germany is infested by 38 species of mosquitoes, or 10 more than those represented in the

British Is.; it is consequently not a matter for surprise if summer days at bathing resorts on the Baltic suffer the same drawbacks as did Hayling I. prior to the era of what is now the British Mosquito Control Institute.

The present pamphlet, a sound and conscientious piece of work, follows familiar lines, except that official reticence concerning proprietary articles, which is the rule in this country, apparently is not practised in Germany. Thus, under larvicides, three proprietary fluids are mentioned by name; and similarly, for the destruction of adult mosquitoes hibernating in houses, several insect-powders and sprays, not known in the British Is., are recommended. In dealing with the systematic carrying-out of anti-mosquito measures, the importance of organized as compared with individual and spasmodic effort is rightly stressed; and interesting details are given of the way in which operations on these lines were performed six years ago in Greater Berlin. *E. E. A.*

Sergent (Et.). Sur l'utilisation du vert de Paris comme larvicide en Algérie. [**Employment of Paris Green as a Larvicide in Algeria.**] —*Arch. Inst. Pasteur d'Algérie.* 1932. Sept. Vol. 10. No. 3. pp. 356–358.

For two years comparative tests have been made on the commonest types of Anopheles breeding places in Algeria, using Paris green (aceto-arsenite of copper, otherwise known as Schweinfurth's green) and petroleum respectively as larvicides. Employing a 2 per cent. mixture of Paris green in fine sand or dust, 50 grams are barely sufficient for the treatment of 1 square metre of water surface; in order to obtain a result, it has often proved necessary to use amounts decidedly larger than those laid down by certain authors—about 5 kilos per hectare, or 11 lb. per 2½ acres. For small scale work the operator stands with his back to the wind, and throws the powder by hand or from a saucepan. Since Anopheles pupae, which succumb to oil, are unaffected by Paris green, the use of the latter must be repeated more frequently than that of petroleum. For this and other reasons, in Algeria at any rate, although the cost of the two methods is about the same, Paris green as a mosquito larvicide appears to be of less practical value than oil. *E. E. A.*

Sergent (Et.), Catanei (A.), Trensz (F.) & Sergent (A.). Expérience de destruction des anophèles au moyen des gambouses dans un barrage-réservoir algérien. [**Experimental Destruction of Anopheles in an Algerian Reservoir by means of Top-Minnows.**]—*Arch. Inst. Pasteur d'Algérie.* 1932. June. Vol. 10. No. 2. pp. 153–156. With 7 figs. (6 on 5 plates).

The dam was closed on 15th April, 1931, and the reservoir, which occupied an area of 1 hectare (nearly 2½ acres), filled in a few days. Several hundred top-minnows (*Gambusia* sp.) were turned in forthwith, and 200 or 300 more were introduced each week until July. Culicine and Anopheline larvae made their appearance between 4th and 26th May, during which period the top-minnows had not had time to multiply to any great extent. On 27th May 25 litres of oil were applied along the eastern border of the reservoir, and by 30th May Anopheline larvae had completely disappeared. By 5th June

the top-minnows were becoming steadily more numerous, while the Culicine larvae showed progressive reduction in numbers until, with the advent of the hot weather, they vanished altogether. Had it not been for the presence of the little fish, the Anopheles larvae would have had to be got rid of by means of larvicides, employed at frequent and regular intervals. The splenic index of the native tribe near the reservoir, which was 3·4 in March, 1931, fell to 0 in November of the same year, at the conclusion of the experiment. *E. E. A.*

Sergent (Etienne). Essai de peuplement d'une rivière d'Algérie (la Réghaia) par les gambouses. [**Stocking an Algerian River with Gambusia.**]—*Arch. Inst. Pasteur d'Algérie.* 1932. Sept. Vol. 10. No. 3. pp. 348–355. With 13 figs.

An account of how an Algerian river was stocked with fish, *Gambusia holbrooki*, for three consecutive seasons, with the disappearance of the malaria-carrying *A. maculipennis*.

Gambusia was introduced into Algeria in 1926 and it has been found easy to stock stagnant waters with it. The more important breeding places are wadis and drainage canals, with swift current in winter and drying into pools in summer. The wadi concerned in the experiment is 30 kilos long and runs north from the Atlas mountains to the Mediterranean. In the winter its valley is flooded and reedy pools are left on the banks. At the end of summer *A. maculipennis* is very numerous and malaria affects all the farms. The fish were put in about 50 at a time at several points every two or three weeks from May to October. It is necessary to restock in the spring because in the narrower parts where the water is high the fish are carried away by the current. At other points restocking is unnecessary. It was found that the fish were able to penetrate the felted mass of vegetation which formed on the surface of water where larvae had been very numerous, that they devoured the larvae but were able themselves to shelter from larger predatory fish, which are numerous in the river. The conclusion reached is that one can stock such a river with gambusia and that they are effective in destroying anopheles larvae. *A. G. B.*

Woods (T. F. M.). **Two Simple Anti-Mosquito Measures.**—*Jl. Roy. Army Med. Corps.* 1932. Dec. Vol. 59. No. 6. pp. 450–452. With 1 fig.

(1) deals with borrow pits which are too deep to drain and too big to fill in. In the monsoon they become filled with water which breeds mosquitoes for many months. A wall or bund 2 feet high by 3 feet wide is built round them which prevents drainage from the surrounding ground. Water collecting in the pits is dealt with by levelling with a slight fall to one end where a pit 4 × 4 × 4 yards is made. In this, which can be surrounded by another wall, the water is easily treated with oil or Paris green. This method has been used with great success at Sialkot in the Punjab.

(2) is a method of oiling slowly running water.

" Ordinary Quaker oats tins, which have air-tight lids, were obtained free from the canteens. These tins were filled with oil and a few stones to make them sink. When required for use they were punctured at the top and bottom by means of a hammer and a nail and thrown into the upstream

end of slowly flowing water. Oil which escapes from the tins and slowly spreads an even film over the surface of the water is replaced by water. It is claimed for this method of oiling that it is clean and economical."

A. G. B.

GORDON (R. M.), HICKS (E. P.), DAVEY (T. H.) & WATSON (M.). **A Study of the House-Haunting Culicidae occurring in Freetown, Sierra Leone; and of the Part played by them in the Transmission of Certain Tropical Diseases, together with Observations on the Relationship of Anophelines to Housing, and the Effects of Anti-larval Measures in Freetown.**—*Ann. Trop. Med. & Parasit.* 1932. Oct. 29. Vol. 26. No. 3. pp. 273–345. With 5 graphs & 2 maps. [42 refs.]

Part I. A survey of the house-haunting Culicidae in Freetown and Kissy.—Kissy is a native village with some 2,000 inhabitants on the coast six miles from Freetown. The climate of the two places is the same, but the general sanitation of Kissy corresponds with that of Freetown thirty years ago. In Freetown the survey was made during the wet season (June to November inclusive) of 1930 and 1931; in this time daily visits between 7 and 9 a.m. were made by one or other of the authors to 3,587 rooms, chiefly in the poorer type of house. The survey was later extended to Kissy and there carried out at all seasons of the year. A total of 5,371 mosquitoes (141 Culicines and 5,230 Anophelines) were captured. During the rainy season in Freetown the Culicine concentration per room was 0·03 and in Kissy 0·13 (the corresponding figure for Lagos being 1·79). The Anopheline concentration was 0·4 in Freetown and 10·5 in Kissy (the corresponding figure for Lagos being 6·3). *A. costalis* was almost the only species of Anopheles taken in houses in Freetown; in Kissy there were about equal numbers of *A. costalis* and *A. funestus*, the latter being in slight excess, and in addition a very few *A. rhodesiensis* and *A. nili*. The species of Culicines taken are also recorded in detail, and it is shown that of the 141 individuals caught in Freetown only 9 (*i.e.* 1 in 15) were "potential carriers" of yellow fever. For comparison a collection was made of mosquitoes taken in the act of sucking blood out of doors. The numbers studied in this way were small, but the dominant Anophelines in Kissy were now *A. theileri* and *A. mauritianus* and the Culicines in Freetown showed a proportion of "potential carriers" of yellow fever of 1 in 5. The results of collections from rooms must therefore be interpreted with caution. The monthly Anopheline incidence in houses in Freetown shows a maximum of 1 per room in August (the height of the wet season) and almost complete absence in the dry season. In Kissy the maximum (23 per room) is also in August and the dry season incidence about 2 per room. When the monthly collections of *A. costalis* and *A. funestus* are considered separately, the *costalis* maximum (13 per room) is reached in July, but the *funestus* maximum (16 per room) is not attained until September. A similar observation has been made by TAYLOR in Nigeria. The authors emphasize that whereas the Anopheline catches are probably fairly representative of the house-haunting individuals, the Culicine catches are not representative either as regards species or numbers.

Part II. Results of dissection of house-haunting Anophelines occurring in Freetown and Kissy.—The infectibility of *A. costalis* and *A. funestus*

by *P. falciparum* was demonstrated experimentally (for the first time in the case of *A. funestus*). Complete development of *W. bancrofti* in both species has already been recorded by HICKS [*ante*, p. 226]. The technique for a complete dissection to demonstrate plasmodia and filariae is then described. This was carried out on 3,267 of the 4,818 female Anophelines collected in Freetown and Kissy. The percentage infections with malaria in Freetown were : *A. costalis*, 11·1 ; *A. funestus*, 12·5 (eight dissections only) ; and in Kissy : *A. costalis*, 16·3 ; *A. funestus*, 7·0 ; *A. nili*, 27·3 (22 dissections only) ; *A. rhodesiensis*, 0. In the case of filaria the figures for Freetown were : *A. costalis*, 5·1 per cent. ; *A. funestus*, 25 per cent. (eight dissections only) ; and for Kissy : *A. costalis*, 14·6 per cent. ; *A. funestus*, 8·0 per cent. ; *A. nili*, 4·5 per cent. (22 dissections only). From the observations recorded in Part I, the authors conclude that Culicines are of negligible importance as carriers of *W. bancrofti* in comparison with the Anophelines. The results here recorded are compared with published data from other parts of West Africa, all of which tend to show that *A. costalis* and *A. funestus* are the only two species of importance.

As regards the seasonal incidence of the infections, the malaria infection rate is similar in the wet and dry seasons, but the filaria rate is twice (in *A. costalis*) and eight times (in *A. funestus*) as great in the wet season as it is in the dry. Since the maximum and minimum temperatures show little difference, it is suggested that the low relative humidity (66) in the dry season is prejudicial to the development of the filaria in the mosquito. The relative ages of Anophelines caught at different seasons were estimated by PERRY'S method of noting the stage of deterioration of their wing scales. In both localities old Anophelines predominated in the dry season, young Anophelines during the rains. In the case of malaria, the percentage infection increased from 4·7 in Grade I (the youngest) to 25·0 in Grade IV (the oldest), but the greatest total number of infections occurred in Grade II. In the case of filaria, both the infection rate and the total number of infections were highest in Grade II. Thus the percentage of infected insects does not increase with age in filaria as it does in malaria, doubtless because the infection of an individual mosquito with filaria is of much shorter duration. Perry's Grade II thus constitutes the most important class of Anophelines.

In West Africa, the gametocyte carriers are almost entirely confined to children. But the authors find no correlation between the number of children in a house and the infection rate amongst the Anophelines captured therein. This suggested that the Anophelines do not remain long in a given house. By means of staining experiments it is proved that they nearly all leave a native house within 24 hours of having fed, and very few return. As regards the type of house and the incidence of Anophelines, it was found that the badly-lighted houses contained almost four times as many per room as well-lighted houses in the same vicinity, but " this does not necessarily indicate that fewer Anophelines enter well-ventilated houses, but rather that they leave them at an earlier hour."

Part III. The history of, and some observations on, anti-mosquito measures in Freetown.—The favourable conditions obtaining in Freetown as compared with Kissy revealed by the observations recorded in Parts I and II are attributed to the anti-malarial measures carried out in Freetown during recent years ; the history of the advances made since 1899 is fully set forth. An extensive scheme of permanent

works estimated to cost some £60,000 was planned in 1930, but was abandoned in 1931 through lack of funds. The authors were able, however, to compare conditions in certain streets in which no modern drainage had been attempted before their first visit in 1930 with conditions in the same streets in 1931 after drainage had been completed. There was a marked reduction in the number of Anophelines.

V. B. Wigglesworth.

Urbino (C. M.) & Laurel (A. G.). **Preliminary Report on Larva and Adult Densities of Stream-Breeding Anophelines.**—*Monthly Bull. Philippine Health Serv.* 1932. Oct. Vol. 12. No. 10. pp. 555–576. With 11 charts, 7 plates & 1 sketch map.

The work of which an account, largely in the form of charts and tables, is given in this paper was carried out at Bulacan, Luzon, Philippine Is., from January, 1930 to June in the following year. It concerns *Anopheles funestus* (= *A. minimus*), *A. aconitus* var. *filipinae*, and *A. barbirostris*, species which breed chiefly in streams, and also includes *A. maculatus*. Five streams affording typical *A. funestus* breeding places were selected for study; from a definite length, generally a kilometre, of each of these, dippings were taken once a week with a dipper of standard dimensions. In tabular form, "Larva density is expressed by the average number of larvae per dip by species, or the total of the average number of larvae per dip from the five streams . . . . adult density is expressed by the total number of adults by the month from the human baited traps . . . . and by the total field catches from the stations around animals . . . ." For 1930, correlation coefficients are given of larvae and adults of the same species; of larva density and rainfall and stream level; and of larva density and trap catches of adults. With one exception (*A. maculatus*), larvae were found to be "directly proportional to their corresponding adults"; it is suggested that the imperfect correlation shown by *A. maculatus* may be due to the increased breeding of this species during the rainy season in places other than streams. On the other hand migration of the adults may sometimes be a disturbing factor. In the case of all stream breeding Anophelines, stream water level, owing to the devastating results to larvae of effective flushing, has an effect on larva density more inverse than that of the total monthly rainfall. Nevertheless "heavy continuous rainfall" may be of importance in reducing adult density, since it may actually kill adult mosquitoes, prevent them from reaching a host, or diminish larva density by causing the flushing of streams. In connexion with mosquito migration, the authors' experience has been that "wind is an important factor," and they add that "There must be an optimum wind velocity during which mosquito migration is most favourable."

E. E. A.

Boyd (Mark F.). **Methods for the Manipulation and Conservation of Anopheline Imagines.**—*Amer. Jl. Hyg.* 1932. Nov. Vol. 16. No. 3. pp. 839–844. With 3 figs.

This paper deals with the manipulation of Anopheline mosquitoes for purposes of malaria therapy. Insects that are developing infection are kept in a cool incubator (20°–22°C.). After they become infective they are stored in a Frigidaire at a temperature varying from 2°–17°C.

They are kept in cages about 6 ins. by 3 ins. made of starched bobbinet supported on a metal frame, by which means the condensation of water on metal or glass surfaces is avoided. They are transferred by means of a special catching apparatus, consisting of a test tube secured over one tine of a spring forceps and a sliding lid placed over the other tine. The small cages have self closing covers made of sheet rubber with a short slit in it. The infective mosquitoes employed for inoculation purposes are placed in small containers made of flanged wooden rings covered with squares of bobbinet held in place by rubber bands ; a series of such rings can be placed in an ordinary petri dish holder. *V. B. Wigglesworth.*

Boyd (Mark F.). **A Note on the Preparation of Anopheline Dissections for Examination.**—*Amer. Jl. Hyg.* 1932. Nov. Vol. 16. No. 3. pp. 836–838.

The author advocates examining gland preparations in a fresh moist condition, but prefers to fix and stain all dissected stomachs before they are examined. These are fixed to the slide or coverslip with Bouin's fixative and stained with Mayer's acid haemalum.

V. B. Wigglesworth.

Mer (G.). **The Determination of the Age of *Anopheles* by Differences in the Size of the Common Oviduct.**—*Bull. Entom. Res.* 1932. Dec. Vol. 23. Pt. 4. pp. 563–566. With 1 fig.

Unless the life of a female Anopheles is longer than the time taken by the parasite to complete its sexual cycle, the insect obviously (the author says " theoretically ") cannot transmit malaria. The length of life of Anophelines at different seasons of the year is therefore an important factor in connexion with the epidemiology of the disease, but hitherto attempts to determine the age of malaria-carrying mosquitoes have dealt chiefly with laboratory-bred specimens, which are little to the purpose. Ovarium differences, noted by Christophers in 1911, are of but limited avail in distinguishing old from " new " female Anopheles, but the changes in the size of the two dilatations, or ampullae, in the common oviduct, which occur during gravidity and persist after egg-laying, afford a surer guide. The author, whose observations were made at Jerusalem on overwintering and captured females of *Anopheles elutus* Edw., gives comparative measurements of the ampullae, and describes his technique. " In most cases," we are told, " exact measurement is not necessary, the difference being quite obvious to a trained eye." *E. E. A.*

Boyd (Mark F.) & Cain (Thomas L.), Jr. **On Large Scale Rearing of *Anopheles quadrimaculatus* in Captivity.**—*Amer. Jl. Hyg.* 1932. Nov. Vol. 16. No. 3. pp. 832–835.

Some improvements on previously described methods for rearing Anopheles larvae are reported, which result in a lower mortality in the early stages and increased size and vigour of the imagines. The main points are (i) maintenance of the water at a constant temperature (70°F. for *A. quadrimaculatus*) ; (ii) provision of abundant and evenly distributed food by supplementing the diet of Fleischmann's yeast with a rich hay infusion ; and (iii) securing a uniform distribution of larvae

and pupae over the water by scattering chaff on the surface. This affords equal opportunities of feeding to all the larvae and obviates cannibalism. Under these conditions metamorphosis from egg to adult required about 21 days. *V. B. Wigglesworth.*

ANDERSON (Drysdale). *Anopheles mauritianus* **as a House Haunter.** [Correspondence.]—*Trans. Roy. Soc. Trop. Med. & Hyg.* 1933. Jan. 31. Vol. 26. No. 4. p. 408.

One day in October, 1932, in the enclosed and partially screened verandah of the writer's bungalow at Onitsha, Nigeria, S.P., half a mile from a flooded river, there were found forty-one females of *A. mauritianus*, nine of which belonged to var. *ziemanni*, and the remainder to var. *tenebrosus*. None of the usual house haunters such as *A. costalis* (=*A. gambiae*) were caught, and during the previous five months, in routine catches made in the house every other day, only seven specimens of this species (one *A. mauritianus* var. *paludis*, and six *A. mauritianus* var. *tenebrosus*) had been taken. *E. E. A.*

RUSSELL (Paul F.) & SANTIAGO (Domingo). *Anopheles minimus* **Larvae from Wells in Laguna Province, Philippine Islands.**—*Philippine Jl. Sci.* 1932. Oct. Vol. 49. No. 2. pp. 219–223. With 3 figs. on 1 plate.

Larvae of *Anopheles minimus*, the chief malaria-carrier in the Philippines, which normally breeds at the edges of streams, were discovered in surface wells in Laguna Province, Luzon, Philippine Islands. Since larvae of this species always occur in large numbers in streams, but appear to be relatively scarce in wells, the latter would not seem to be of much local importance in connexion with malaria. It is pointed out that the case may be otherwise where a well-marked dry season causes the stream breeding places of *A. minimus* to disappear, and that further investigation is needed. *E. E. A.*

ROUBAUD (E.), COLAS-BELCOUR (J.) & GASCHEN (H.). Etude du comportement sexuel comme caractère génétique chez l'*Anopheles maculipennis*. [**A Study of Sexual Behaviour as a Genetic Character in** *Anopheles maculipennis*.]—*Bull. Soc. Path. Exot.* 1933. Jan. 11. Vol. 26. No. 1. pp. 27–29.

This paper is concerned with the two forms of *A. maculipennis* found in Holland though as yet not in England, in connexion with which Roubaud in a previous contribution introduced the terms Eurygamy and Stenogamy (see this *Bulletin*, 1932, Vol. 29, pp. 831–832). While the eurygamous, typical form, which is large and has long wings, will not mate in a confined space, but must needs make a nuptial flight as a preliminary to copulation, the small Dutch variety called *atroparvus* is stenogamous, and breeds freely in cages of very limited dimensions. In Holland, BUCK, SCHOUTE and SWELLENGREBEL, who succeeded in crossing the two forms, found that in a confined space the only means of obtaining fertilized females of the large form was to enclose with them males belonging to the other. Using females of the large form, of Dutch origin, and stenogamous males of Norman stock, the present authors have repeated this procedure at the Institut Pasteur, Paris, in order to observe the fate of the eurygamous character in the cross thus produced. At the outset,

more than one hundred specimens of both sexes of the large form, from eggs laid by wild-caught females imported direct from Holland, were kept together in the same cage for nearly two months and fed on guineapigs ; no fertile eggs were obtained, and repeated dissections showed no evidence of fertilization having taken place. Some ten of these eurygamous and homodynamous females were then placed in a cage with males of the above-mentioned, stenogamous and heterodynamous Norman stock. Fertilization was affected without difficulty. The adults of the resultant first cross generation mated in normal fashion, in a cage one-twentieth of a cubic metre in size, and the females laid several batches of fertile eggs. The eurygamy of the Dutch stock therefore appeared in the guise of a Mendelian *recessive*, the stenogamy of the Norman form in that of a *dominant* character. But although the adults of the second mixed generation, which emerged in August, were kept together in a cage from 16th August until 6th October, not a single batch of fertile eggs was laid. It was not possible to pursue the experiment further on Mendelian lines, but we see that eurygamy, latent in the first mixed generation, reasserted itself in the second, thus coming within the category of Mendelian genetics. *E. E. A.*

MacGregor (Malcolm E.). **The Occurrence of Roubaud's " Race Autogène " in a German Strain of *Culex pipiens* in England : with Notes on Rearing and Bionomics.**—*Trans. Roy. Soc. Trop. Med. & Hyg.* 1932. Nov. 30. Vol. 26. No. 3. pp. 307–314.

In 1929 Roubaud, working in France, recorded the occurrence of what he termed an " autogenous " race of the common gnat or mosquito (*Culex pipiens*). Provided that the temperature of its environment does not sink lower than 16° to 18°C., this race continues to breed throughout the year, and moreover in its case a meal of blood is not a necessary preliminary to the laying of fertile ova. A batch of adults, descended from a consignment of larvae and eggs of *C. pipiens* received by the author from Germany, was fed upon a weak solution of honey, and four days after emergence produced several egg-rafts. The latter were smaller and less symmetrical than rafts laid by *C. pipiens* out-of-doors, and contained less than half the number of eggs present in the normal raft ; but, when placed on " rich hay infusion," with or without the addition of rabbits droppings, and kept at a temperature of between 23° and 28°C., larvae which attained a large size were produced in quantity. From these were obtained many large adults, which four days later deposited quantities of the small, asymmetrical egg-rafts. In this way, in the autumn of 1932, an " autogenous " race of *C. pipiens*, producing a fresh generation every nineteen or twenty days, was established in the Wellcome Entomological Field Laboratories, at Wisley, Surrey.

The author failed to produce an " autogenous " strain by supplying dilute honey-solution to the vigorous adult progeny of wild-caught English *C. pipiens*, since no eggs were laid ; hence he concludes that " the British race of *C. pipiens*, in this locality at any rate, is not capable of ' autogenous ' development." On the other hand, as previously indicated by Roubaud, newly emerged females of the " autogenous " race deposited small egg-rafts without the aid of honey or any other food, but in no case did females of the British race lay eggs when kept solely on a fruit diet. In November, the sexes of *C. pipiens*

were observed to mate freely during the late afternoon and evening. Parthenogenesis is apparently impossible; virgin females of the "autogenous" strain, supplied with dilute honey-solution and with water in a dish, and kept constantly at 22°C., laid a few egg-rafts, but all the ova were infertile.

A description is given of the special technique employed with complete success at the Wisley Laboratories for breeding and rearing both the normal and "autogenous" strains of *C. pipiens* throughout the year. "At a standard atmospheric temperature of 22° to 25°C. coupled with a high level of atmospheric humidity," 80 to 100 per cent. of the females feed to repletion on birds as soon as opportunity is offered. When females of the "autogenous" race were fed on blood prior to oviposition, the egg-rafts subsequently laid were no larger than those of the small "autogenous" kind. On the other hand a meal of blood *after* the laying of the latter type of rafts resulted in very much larger rafts, which, however, were composed of fewer eggs than those contained in normal *C. pipiens* rafts. The "autogenous" faculty was found to be firmly established in the foreign race, and to be manifested by females of the sixth generation, even when those of the previous five generations had been fed on blood.

The paper affords some measure of the loss sustained by medical entomology through its author's untimely death in January, 1933.

E. E. A.

Djaparidse (P. S.). *Stegomyia fasciata* (=*Aedes argenteus*) in Kutais. [*Ae. aegypti* **in Kutais, Georgia.**]—*Arch. f. Schiffs- u. Trop.-Hyg.* 1932. Nov. Vol. 36. No. 11. pp. 608–609.

The carrier of yellow fever and dengue is found on the shore of the Black Sea from Batum to Gagri and in September 1929 and 1930 the author found it in quantity in the town of Kutais, which is 110 kilometres from the nearest port. The introduction of yellow fever is improbable but dengue might easily be brought in from Greece.

A. G. B.

Bode (H. G.). Zur Kenntnis atypischer Mückenstichreaktionen (*Culicosis bullosa*). [**Atypical Reactions to Gnat Bites.**]—*Dermat. Woch.* 1933. Jan. 7. Vol. 96. No. 1 pp. 7–13. With 2 figs.

An affection of the skin, characterized by large vesicles containing serous fluid, occurring only during the summer months and on exposed parts of the body, has been described by Siemens [this *Bulletin*, Vol. 29, p. 843] under the name Culicosis bullosa and ascribed by him to mosquito bites. This rare condition is here reported in two sisters who had suffered for three consecutive summers. The formation of vesicles was produced experimentally by the bites of *Culex pipiens*; though not by intradermal injection of an emulsion of their bodies. The condition is regarded as an allergic reaction occurring in skin which has become highly sensitized. *V. B. Wigglesworth.*

Engelhardt (W.). Ueber die Ursachen atypischer Mückenstichreaktionen. [**The Causes of Atypical Reactions to Mosquito Bite.**]—*Arch. f. Dermat. u. Syph.* 1933. Jan. 20. Vol. 167. No. 2. pp. 307–314. [11 refs.]

Two cases of the unusual type of reaction to mosquito bite known as Culicosis bullosa are described. These cases showed isolated vesicles

on the legs, many of them as large as cherries but with no inflammation of the surrounding skin and causing very little irritation. In both cases cultures from the contents of the blebs yielded budding fungi. A study of the literature suggests that there are two types of reaction to mosquito bites in which vesicles are formed : (i) that described above where the vesicles are very large and isolated and associated with almost no irritation ; this condition Engelhardt believes to be caused by yeast fungi from the crop of the mosquito being injected into the wound and not by sensitization of the skin to the poison of the mosquito ; (ii) cases where small vesicles develop in an area intensely swollen and inflamed as the result of many bites in a restricted space ; this condition he attributes to the excess of poison injected by the mosquito coupled with the subsequent rubbing and scratching. To what extent an allergy of the skin contributes to these reactions is at present undetermined. *V. B. Wigglesworth.*

Parrot (L.). Nouvelles observations sur la biologie de *Phlebotomus papatasi* (Scop.). [**Biology of** *P. papatasii.*]—*Arch. Inst. Pasteur d'Algérie.* 1932. Sept. Vol. 10. No. 3. pp. 407–409. With 2 figs. on 1 plate.

Larvae of Phlebotomus are known to feed mainly on organic detritus and on unicellular algae. Parrot finds that larvae of *P. papatasii* will thrive on a diet of dead leaves (from elm, plane, etc.) without any other source of nitrogen, though they will not eat fresh leaves. The larger larvae devour the entire substance of the leaves with the exception of the veins. He records also a few observations showing the increased rate of development at artificially raised temperatures.

V. B. Wigglesworth.

Pawlowsky (E. N.), Stein (A. K.) & Perfiljew (P. P.). Experimentelle Untersuchung ueber die Wirkung des Phlebotomusstiches auf die Menschenhaut. [**The Effect of Phlebotomus Bite on Human Skin.**]—*Ztschr. f. Parasitenk.* 1932. Nov. 18. Vol. 5. No. 1. pp. 1–13. With 8 figs. [34 refs.]

The first half of this paper is a fully documented account of the present state of knowledge on the mechanism of biting in Phlebotomus, the structure of the salivary glands and the effects of the bite. In the second half, original observations on the effects of the bite are given. Well marked reactions accompanied by intense itching were obtained in subjects who had never been bitten by Phlebotomus before ; therefore the effects of Phlebotomus bite cannot be due *solely* to allergy resulting from previous sensitization. Several of the resultant papules were excised and studied histologically ; the horny layer showed marked swelling with separation of the cells ; the vessels of the corium were dilated and surrounded by an infiltration of leucocytes (in one case largely made up of eosinophils) and lymphocytes. These observations indicate that Phlebotomus bite causes an acute inflammation.

V. B. Wigglesworth.

Myers (J. G.). **Report on the Sandfly** (*Culicoides*) **Investigation in the Bahamas.**—18 pp. [Received from Colonial Office November 12, 1932.]

With the rise of the tourist trade in New Providence, the " sand-fly," *Culicoides furens*, has become a factor of considerable economic

importance by reason of the annoyance caused by its bite. The breeding of this species is probably almost confined to certain restricted coastal mangrove swamps (the precise location of which is reported) where the sand is mixed with humus, well shaded, and water-logged with salt or brackish water. The females bite chiefly about sunrise and sunset (but in dense shade they will bite at any hour) particularly on still, sultry nights following rain, with a temperature of 80° or higher. The only sound method of eliminating the "sand-fly" is to fill in or dredge out the swamps in which it breeds, which in itself would be a desirable step in the development of the island. Failing this, great reduction could probably be secured by clearing completely all vegetation which shades the water-logged soil and so exposing it to sun and wind. As a palliative measure the use of bed nets is advocated, the author regarding "as pure superstition the belief that a net of common cheesecloth, slung well above the bed, excludes so much air as to cause discomfort." Protection may also be secured by spraying the mosquito screens with kerosene in which has been steeped pyrethrum powder at the rate of a quarter of a pound in 3 pints of kerosene. The best-known chemical deterrent is oil of pennyroyal, and this may be mixed in equal parts with the coconut oil used against sunburning. In experiments during a heavy infestation it was found that a limb treated with this mixture remained in comfort for two hours, while the state of the other was almost intolerable. To alleviate the after-irritation of the bites, either wood alcohol or 7 per cent. ammonia water is highly effective.

V. B. Wigglesworth.

Hall (David G.), Jr. **Some Studies on the Breeding Media, Development, and Stages of the Eye Gnat *Hippelates pusio* Loew (Diptera : Chloropidae).**—*Amer. Jl. Hyg.* 1932. Nov. Vol. 16. No. 3. pp. 854–864. With 8 figs. [14 refs.]

The eye gnat, *Hippelates pusio*, is one of the factors limiting development of the Coachella Valley, California ; causing much annoyance from its habit of feeding around the eyes and nose of man and animals and being responsible for the prevalence of conjunctivitis, especially among children of pre-school age. In nature the larvae were found in decaying meat, in excrement, and in decaying fruit and vegetables. In the laboratory human excrement proved to be the most favourable medium for rearing larvae, the life cycle from egg to adult varying with the conditions from 11 days to more than 3 months. These observations suggest that the problem of controlling the eye gnat is one of sanitation as well as one of agricultural practice. All stages of the insect are fully described and illustrated.

V. B. Wigglesworth.

Patton (W. S.). **Studies on the Higher Diptera of Medical and Veterinary Importance. A Revision of the Species of the Genus *Musca* based on a Comparative Study of the Male Terminalia. I. The Natural Grouping of the Species and their Relationship to Each Other.**—*Ann. Trop. Med. & Parasit.* 1932. Oct. 29. Vol. 26. No. 3. pp. 347–405. With 26 figs. [29 refs.]

On the basis of an exhaustive study of the male terminalia (genital armature) of forty-one out of forty-four species of *Musca* known to him, the results of which are here given, the author considers that he has

succeeded in establishing the relationships of the species, in correcting certain errors in determination previously made by him, and in fixing the identity of species so definitely " that any one can determine them for himself with certainty." Patton finds that the species of *Musca*, according to the characters afforded by the male terminalia (paramere, phallosome, anal cerci and lateral processes of the fifth ventrite) are naturally divisible into three groups, respectively designated by him *domestica*, *sorbens* and *lusoria*, according to the trivial name of the oldest species in each group. In the first-mentioned group, *M. planiceps*, although in other respects highly specialized, since it both sucks blood and is larviparous, depositing a third-stage larva, is nevertheless, according to the characters afforded by phallosome and paramere " one of the simplest forms . . . closely related to *domestica* and its allies." In the *sorbens* group *M. conducens*, a haematophagous species, which, however, must perforce depend for its food on the prior activities of other blood-sucking flies, is of interest as illustrating an early stage in the evolution in the genus *Musca* of a proboscis capable of drawing blood. The *lusoria* group, which consists of twenty-three species already known to the author, includes *M. autumnalis* and other serious pests of farm stock.

The greater portion of the latter part of the paper is devoted to a discussion of previous attempts to divide the genus *Musca* into natural groups. [This is not the place in which to debate the question whether the characters afforded by the male terminalia are, for the purpose of deciding as to the natural grouping of species, really of overriding value. It may, however, be said that it is not easy to see why, in the evolution of the terminalia as in that of other structural details, convergence should not have played a part. The author announces that he has long been preparing a revision of the Stomoxys group, and that, having " examined the male terminalia of many species of seven of the genera," he has " come to the conclusion that there is only one genus here, and that that must be the oldest, Stomoxys." In lists which follow a few pages later, practical expression is given to this conclusion. We venture, however, to prophesy that the death warrants of *Lyperosia*, *Haematobia*, *Stygeromyia et haec genera omnia* will not be so easily signed.] *E. E. A.*

FORD (Norma). **Observations on the Behaviour of the Sarcophagid Fly, *Wohlfahrtia vigil* (Walk.).**—*Jl. Parasitology*. 1932. Dec. Vol. 19. No. 2. pp. 106–111.

If Miss Ford's very interesting observations, made upon five adult specimens, are to be regarded as conclusive, *Wohlfahrtia vigil*, a frequent cause of cutaneous myiasis in infants and other young mammals in North America, definitely belongs to the number of those myiasis-producing flies, which, in nature, are invariably parasitic in the larval stage.

Two males and one female of *W. vigil*, from larvae removed from an infant of four months and reared artificially on liver, manifested complete indifference to the latter substance either fresh, stale or rotten, but fed all day upon a particular lump of sugar. In a cage measuring 3 by 2 by 2 ft. mating took place three days after emergence, and the female, after depositing at intervals three batches of larvae, died of senile decay at the age of 53 days. Five days after the female had mated, either a guineapig or rabbit was placed in the cage

daily for periods of half-an-hour, an hour, or two hours at a time. Initial indifference on the part of the fly was followed by awakening and increasing interest, and repeated attempts, often successful, to reach or alight on the animal's head, the eye appearing to be the point of attraction ; no notice was taken of shaved areas or abrasions on the body. On the afternoon of the eighth day after mating, " when a guinea-pig was put in the cage, *W. vigil* immediately lit on the head close to the eye, and poured out a stream of white larvae . . . . The stream resolved itself into actively moving maggots which in a few seconds disappeared among the long hairs." A second mating (with a male of the second generation) took place when the female was forty-one days old, and eight and nine days later small batches of larvae were found on two pieces of liver ; but this was only after repeated futile attempts on the part of the now aged and decrepit fly to crawl up the animals.

The author thinks it probable that, when an infant is the victim of *W. vigil*, larviposition takes places on the cheek, whence the larva migrate in various directions and then burrow into the skin. She states that " in the cases with infants recorded in Ontario the larvae have entered the skin most commonly on the neck, chest, shoulders, arms, cheeks, and eyelids." She also considers that the action of her captive flies in spurning the supposed attraction of meat or carrion, and restricting themselves to a diet of unobjectionable sugar, clearly shows that it is not necessary for a baby to be in an uncleanly or neglected condition in order to secure the undesirable attentions of a female *W. vigil*. Apart from the interest of the primary observations, this excellent account of the behaviour of *Wohlfahrtia vigil* in captivity, including the playful antics of the males, is well worth reading.

E. E. A.

VAN SLYPE (W.). Trois cas de myiase intestinale à *Apiochoeta scalaris*. [**Three Cases of Intestinal Myiasis due to** *A. scalaris*.]—*Ann. Soc. Belge de Méd. Trop.* 1932. Dec. 30. Vol. 12. No. 4. pp. 581–582.

Among 341 stools from native patients in the hospital at Lomami, Belgian Congo, 3 showed eggs of Arthropods. Placed on agar-agar, these eggs proved viable and yielded larvae of *Apiochoeta scalaris*.

V. B. Wigglesworth.

POMEROY (A. W. J.) & MORRIS (K. R. S.). **The Tsetse Problem on the Eastern Cattle Route in the Gold Coast. (With an Appendix by K. R. S. Morris on an Ecological Study and Experimental Clearing at Makongo.)**—*Bull. Entom. Res.* 1932. Dec. Vol. 23. Pt. 4. pp. 501–531. With 8 figs., 3 maps (1 coloured folding) & 2 plates. [12 refs.]

The work of which an account is given in the joint paper is summarized by the authors as :—" (*a*) An investigation into the possibilities and economic value of controlling tsetse in certain areas of the Northern Territories of the Gold Coast ; (*b*) the application of control measures ; (*c*) a careful study of the effect of the measures undertaken."

In the Gold Coast down to the end of 1925, when research into the twin problems of tsetse-flies and trypanosomiasis was definitely initiated, the veterinary rather than the medical side of the problem was held to be the more important, and conditions on the main route used by cattle proceeding from the Haute Volta (French territory) to Kumasi, in Ashanti, accordingly became the subject of investigation. Information acquired during the course of the work seemed, however, to indicate that the local importance of human trypanosomiasis may have been underrated, and a description of an experimental clearing at Makongo, where sleeping sickness is endemic, is furnished in the Appendix.

As regards cattle, it was in the first place necessary to determine whether or not the animals were already infected with trypanosomiasis before crossing the French border. By means of an extensive series of blood-examinations it was found that, whereas " the infection rate at the border was very low, at Yeji [on the Volta River, half way to Kumasi] there was a marked increase in infection, while at Kumasi, the distributing market for cattle, the infection rate had increased by as much as 60 per cent. in the wetter months." There could thus be no doubt as to the side of the border on which the trouble lay, and with the help of funds furnished by Government experimental clearings were made at a number of tsetse-infested points (river crossings, shown on the coloured map) on the cattle route. The result, corroborated by a remarkable reduction in the number of immigrant cattle showing trypanosomes in their blood, is the establishment of definite control of tsetse-flies in the cleared areas, and should do much to hearten those engaged in similar tasks elsewhere.

The trypanosomes found in the cattle, as determined by the pathologists of the Gold Coast Tsetse staff, were *Trypanosoma vivax*, *T. congolense*, *T. brucei*, *T. tragelaphi* and *T. theileri*. The first-mentioned species predominated, and in 1929 at the Nasia River crossing, which before clearing was " by far the densest fly belt " (*Glossina tachinoides*), this trypanosome was the one most commonly found in dissected flies. It was also met with at that time in the blood of game killed in the immediate vicinity of the cattle route ; but in the following year, after clearing had been effected, the same number of examinations revealed no pathogenic trypanosomes, " showing that the cattle-fly-game circle of infection was now broken."

On the northern portion of the cattle route *Glossina palpalis* and *G. tachinoides* were the only species of tsetse of economic importance, and at points where rivers were crossed by the road it was resolved to clear the banks when these flies were found. " In order to facilitate the carrying out of the work by non-technical officers, a standard method was adopted for clearing at all points. The bush was completely cleared for a distance of half a mile along the river on either side of the point of the cattle crossing and the clearing was limited to a width of 20 yards on each bank. The work was undertaken by the District Commissioners in charge of the areas." Descriptions are given of the respective clearings, and their results upon the incidence of tsetse ; the re-growth, usually of a character very different from that of the original vegetation, is also described. Owing to the varying nature of the re-growth of vegetation after clearing, and the resultant effect as regards the reintroduction of tsetse, the vital importance of a preliminary study of the plant community, as well as of the fly community at each place is emphasized. Contrasts are afforded by two extreme

cases—the Tamne River and the Makongo clearings. In the former, while during the first year there was no re-growth worth mentioning, during the second year clumps of *Mimosa asperata* resulting from water-borne seeds from up-stream, with the addition of a few shrubs and a plentiful crop of long grass, " produced a cover sufficient to harbour considerable numbers of *Glossina tachinoides*. At Makongo, eight months after the work of the clearing was finished, a low impenetrable re-growth of swamp-grass, shrubs and creepers had invaded the whole of the cleared areas, forming a plant community apparently inimical to the invasion of tsetse."

In the Appendix, Morris suggests the possibility of securing a riverside clearing against reinvasion by *G. palpalis* and *G. tachinoides* by maintaining re-growth of this kind at each end, and the description calls to mind the thicket-barriers against other species of tsetse with which experiments are being made by SWYNNERTON in Tanganyika Territory. Prolonged inundation on the other hand, if of annual recurrence, *drowns* the stumps of felled trees which would otherwise burst into life afresh, and thus has an inhibiting effect on re-growth. In the Gold Coast, though an area of comparatively small extent, the variety of natural conditions is such, and these factors themselves are so closely interrelated, that it is exceedingly difficult to state the precise requirements of any one of the numerous endemic species of Glossina. While the distribution of these species, like the occurrence of the genus itself, is mainly dependent upon vegetation, " temperature and humidity seem the factors of greatest importance in influencing the metamorphosis of the fly in the pupal state." *Glossina palpalis* and *G. tachinoides*, within the type of plant-environment necessary for their continued existence, appear as regards their distribution to be influenced to a large extent by the presence of certain favoured hosts. The latter in the case of *G. palpalis* are normally wild animals, or domestic stock when easily accessible, while " in certain areas " the authors find reason to believe that " man is definitely the preferred host." *G. tachinoides*, another riverside fly, which nevertheless, where there is water, " seems able to survive in quite open country " without much shade, appears to prey by choice on wild game and reptiles.

In the Appendix, Morris describes and illustrates by means of maps and graphs the striking results on *G. palpalis* of clearing *Isoberlinia doka* woodland from the vicinity of the cattle road at Makongo. The clearing, for the elimination of *G. tachinoides* and *G. palpalis*, of a neighbouring riverside belt of *Ficus congensis* had not proved so successful at the close of the period under observation. *E. E. A.*

TAYLOR (A. W.). **Pupal Parasitism in** *Glossina morsitans* **and** *G. tachinoides* **at Gadau, Northern Nigeria.**—*Bull. Entom. Res.* 1932. Dec. Vol. 23. Pt. 4. pp. 463–467. With 1 fig.

During two years' work in the Sherifuri-Gadau area, 106,047 pupae of *Glossina tachinoides* and 17,346 pupae of *G. morsitans* were collected " in order to provide supplies of ' clean ' tsetse for trypanosome transmission work in the Tsetse Investigation Laboratory, Gadau." A small proportion of these pupae produced other (parasitic) insects instead of tsetse, and the records are tabulated in this paper.

In fighting insect vectors of disease, it is well if the attack can be delivered from more than one direction, with the help of any allies

whose services can be secured, and there is something fascinating in the mere idea of controlling one insect by means of another. As regards tsetse-flies, however, the matter has not as yet progressed beyond the stage of preliminary investigation, and an apparently inconclusive experiment by LAMBORN in Nyasaland (1925). As Taylor pertinently remarks :—" Although theoretical objections to applying biological control methods to *Glossina* exist, it may be doubted whether the possibilities of these methods as a means of attaining at least a local degree of control of tsetse have been sufficiently explored." For the biological control of a noxious insect, an effective agent is obviously never to be found on the spot, but must always be imported from elsewhere. Were it seriously intended to experiment with insect parasites for the control of tsetse in Northern Nigeria, it might be worth while to try to import them from Southern Rhodesia, where (assuming that the records are reliable) CHORLEY in 1922–23 found that, at the end of the dry season, no fewer than 84 per cent. of *G. morsitans* pupae from which insects emerged were parasitized, by a Hymenopteron (*Mutilla glossinae*) and by one or more species of Diptera (*Thyridanthrax*) [see this *Bulletin*, Vol. 27, p. 314]. A vastly lower percentage of parasitism is revealed by Taylor's observations in the Sherifuri-Gadau district, and the author finds that " the Bombyliid *Thyridanthrax argentifrons*, Aust., is in this area the only naturally occurring pupal parasite of *Glossina* of any importance. This fly has formed as much as 6 per cent. of total emergences from *G. tachinoides* puparia in the month of March, and 2 per cent. of total emergences from *G. morsitans* puparia for the month of April." *E. E. A.*

JOBLING (B.). **A Revision of the Structure of the Head, Mouth-Part and Salivary Glands of** *Glossina palpalis* **Rob.-Desv.**—*Parasitology*. 1933. Jan. Vol. 24. No. 4. pp. 449–490. With 11 text figs. & 32 figs. on 5 plates. [33 refs.]

Considering the vital importance of the genus *Glossina* to man and beast in Tropical Africa, we have had to wait long for an adequate account of the minute anatomy of the head of a tsetse-fly, and of the organs and structures brought into play when its bite is inflicted. The deficiency has now been remedied by this admirably detailed and beautifully illustrated paper, which is a model of clearness in all respects. In a highly specialized genus like Glossina, the anatomy of the structures dealt with is practically the same throughout ; Jobling compared the head and mouth-parts of *G. palpalis* with those of *G. fusca*, *G. brevipalpis* and *G. morsitans*, and found little difference except in dimensions. [" Mouth-part," both in the title and in a subsequent heading, has a curious appearance shorn of its final " s," and should have received attention while the paper was yet in proof. It is also noted that the author, following PETERSON, employs the term " vertex " in a sense different from that in which it is used by Dipterists and other entomologists, and designates what is commonly called the frontal stripe the " mediovertex." This entails the employment of the further term " laterovertex," so that we have " laterovertices " for the parafrontals. In the interests of students, the addition of synonyms to a terminology already sufficient and fairly extensive is to be deprecated.] *E. E. A.*

HASE (Albrecht). Beobachtungen an venezolanischen Triatoma-Arten, sowie zur allgemeinen Kenntnis der Familie der Triatomidae (Hemipt.-Heteropt.). Beiträge zur experimentellen Parasitologie 8. [**Observations on the Triatomidae of Venezuela together with a General Account of the Family.**]—*Ztschr. f. Parasitenk.* 1932. Sept. 5. Vol. 4. No. 4. pp. 585–652. With 27 figs. & 1 folding plate (map). [4 pages of refs.]

The first part of this valuable paper is a review of twenty pages of the present state of knowledge about the Triatomidae. The history of the subject falls into (*a*) the period of pure systematics, (*b*) the period following on CHAGAS' discovery in 1909 of the transmission of South American trypanosomiasis, during which the parasitological importance of the genera and species was intensively studied, and (*c*) a very recent period during which these insects are being used for studies on insect physiology and ecology. Certain of the gaps in our present knowledge are indicated, and the danger of Chagas' disease spreading to other parts of the tropics is pointed out; for *Triatoma rubrofasciata* occurs in the tropical zone all round the world. There follows a key to the 9 genera of the family, with representative figures of most of these, and a complete list of the 70 known species giving their geographical distribution. Their vernacular names are given, and the ecological distribution of many is defined. Of these 70 species, 15 (belonging to 5 genera) are proved carriers of Chagas' disease—among this number is *T. rubrofasciata*. The geographical distribution of the disease is very incompletely worked out; in this connexion the value of "xeno-diagnosis," as defined by BRUMPT, for the recognition of obscure cases is emphasized.

In Venezuela 11 species belonging to 6 genera have been recorded, and 6 of these are known to be carriers of trypanosomiasis. Three of the latter, *Panstrongylus geniculatus*, *Eratyrus cuspidatus* and *Rhodnius pictipes*, were bred and studied in captivity, the technique of rearing and transporting to Europe being described. There has been much controversy as to the effects of the bites of Triatomidae. The author finds that single bites by the 3 species quoted had no effect at all on his skin; though when a number of larvae were permitted to feed together in a restricted area there was very slight itching coming on in the evening for a few days after the experiments. [The reviewer has performed the same experiment with larvae of *Rhodnius prolixus* and developed numerous small papules causing almost unbearable itching, especially in the evenings, and persisting more than 3 weeks.] When larger quantities of saliva were injected intradermally a definite wheal was produced but burning and itching were absent. Further, the saliva appeared to have a local anaesthetic effect. Experiments indicate that heat and smell are the chief stimuli to induce biting, vision being unimportant. The paper also includes original data on the duration of the act of feeding, the amount of blood ingested, the resistance to starvation (this often exceeds 6 months), the behaviour during pairing, and the phenomena of cannibalism and coprophagy. There are also facts relating to the number of eggs laid and the duration of the egg stage. The variability in the latter figure recorded by BUXTON (see this *Bulletin*, Vol. 28, p. 533) is shown to be due, in part at least, to the female retaining some of the eggs in the oviduct until considerable development has taken place, retention being caused presumably by the pressure of a recent meal. An extensive bibliography is given. Altogether the paper will form an admirable starting point for students of this subject.

V. B. Wigglesworth.

BUXTON (P. A.). **The Relation of Adult *Rhodnius prolixus* (Reduviidae, Rhynchota) to Atmospheric Humidity.**—*Parasitology.* 1932. Oct. Vol. 24. No. 3. pp. 429–439. With 4 figs.

MELLANBY (Kenneth). **Effects of Temperature and Humidity on the Metabolism of the Fasting Bed-Bug *Cimex lectularius*, Hemiptera.** —*Ibid.* pp. 419–428. With 3 figs.

These two papers deal with substantially the same problem and may be considered together, the object of the authors being to discover the general principles which govern the physiological effect of different temperatures and humidities upon insects. In a previous publication Buxton has shown that the rate of evaporation of water from a number of insects is very nearly proportional to the saturation deficiency of the air. In the case of *Cimex lectularius*, Mellanby finds that in dry air the loss of water follows this law, but that in moist air (over 60 per cent. relative humidity) the rate of loss becomes relatively greater. It is suggested (though experimental evidence is wanting) that this may be due to the spiracles being kept closed most of the time in dry air, and open most of the time in moist. Protein is the chief reserve substance consumed during starvation. If the insect is starved in air with a relative humidity between 0 and 60 per cent., the proportion of dry matter in its body gradually rises. But at 90 per cent. this remains constant, and the time of survival is increased. This result reflects the ability of the bed-bug to get rid of its water or metabolism at high humidities by evaporation (*vide supra*) and is in conformity with the habit of this insect, which conceals itself in small spaces where the humidity of the air is high. In the case of *Rhodnius prolixus*, Buxton shows that when the insect is kept in air with a relative humidity of 60 per cent. or less, not only is more water lost by evaporation (as it is in Cimex) but less is produced by metabolism ; that is, the rate of metabolism falls off. Thus the proportion of dry matter in the body of the insect is increased in two ways, and it becomes impossible to test the law of saturation deficiency. The great resistance of Rhodnius to dry conditions may be illustrated by the fact that unfed male adults could be starved for 32 days at 23°C. over phosphorus pentoxide with only two deaths among eleven insects; and it is calculated that the insect will tolerate a change in concentration of the body solids from the normal 26 per cent. to about 40 per cent. of the total weight.

In both papers the conclusions are based on long series of experiments and in every case the significance of the results is proved statistically.

V. B. Wigglesworth.

MITSUHORI (Saburo). **A Study on the Destruction of a House-infesting Tick (*Liponyssus Nagayoi*).**—*Jl. Public Health Assoc. Japan.* 1932. Nov. Vol. 8. No. 11. pp. 1–4.

The mite (*Liponyssus nagoyoi*) infesting *Rattus rattus* (and, rarely, *R. norvegicus*) has become increasingly prevalent in the town of Nagoya during recent years. It attacks man, causing severe itching, and has been shown by YAMADA to be capable of transmitting plague. The resistance of these mites to various insecticides has been studied and the results tabulated ; but no conclusions of special interest are reached. There is some doubt whether *L. nagoyoi*, Yamada is not a synonym of *L. bacoti*, Hirst.

V. B. Wigglesworth.

Dunn (Lawrence H.). **Notes on the Tick, *Ornithodorus talaje* (Guer.), infesting a House in the Canal Zone.**—Reprinted from *Psyche.* 1932. Vol. 38. No. 4. pp. 170–173.

This appears to be the first time that *Ornithodorus talaje* has been recorded as attacking man in Panama. The presence of the ticks was associated with an abundance of rats, and when these were eliminated the ticks disappeared. The bite produced a severe local reaction in one of the inmates of the house, but only a very slight reaction in the author. *V. B. Wigglesworth.*

Boyé (R.). La Papillonite Guyanaise. [**Urticaria caused by a Moth in Guiana.**]—*Bull. Soc. Path. Exot.* 1932. Dec. 14. Vol. 25. No. 10. pp. 1099–1106.

A saturniid moth belonging to the genus *Hylesia* was shown by Leger and Mouzels in 1918 to be responsible for a pruriginous dermatitis in Cayenne. Boyé now confirms and extends their observations. The affection is caused by barbed hairs connected with poison glands distributed over the abdomen of the moth, and the dermatitis may be set up, not only by handling the insects but from contact with these hairs, which are scattered over the furniture of houses when the insect flutters round the lights. The histology of the poison glands and the life history of the moth are described. There are four broods in the year, but the numbers of the insects vary greatly from time to time. During a heavy flight the chief measure of protection is to extinguish all lights in the houses. The larva also has urticating properties, but these have not been closely studied. *V. B. Wigglesworth.*

Hinman (E. Harold) & Faust (Ernest Carroll). **The Ingestion of the Larvae of *Tenebrio molitor* L. (Meal Worm) by Man.**—*Jl. Parasitology.* 1932. Dec. Vol. 19. No. 2. pp. 119–120. [13 refs.]

Very few records of human ingestion of mealworms exist in the literature ; these are quoted in this paper, and two new cases reported. In one of these a mature larva was vomited, and in the other a young larva was recovered in a tonsil at tonsillectomy. The fact that mealworms occur so frequently in human foods and that rodents are commonly associated with cereals suggests that they are probably responsible for most cases of human infestation by the rat tapeworm, *Hymenolepis diminuta.* *V. B. Wigglesworth.*

MacGregor (Malcolm E.). Certain Pathological Effects of Ultra-Violet Radiation on Mosquito Larvae and Pupae.—*Proc. Roy. Soc.* Ser. B. 1932. Nov. 1. Vol. 112. No. B 774. pp. 27–38. With 1 plate.

True (Gordon Haines), Jr. Studies of the Anatomy of the Pajaroello Tick, *Ornithodorus coriaceus* Koch. I. The Alimentary Canal.—*Univ. California Public. Entom.* 1932. Vol. 6. No. 3. pp. 21–48. With 3 plates & 17 figs. [13 refs.]

Wigglesworth (V. B.). The Effect of Salts on the Anal Gills of the Mosquito Larva.—Reprinted from *Jl. Experim. Biol.* 1933. Jan. Vol. 10. No. 1. pp. 1–15. With 7 figs. [14 refs.]

KALA AZAR.

ADLER (S.) & THEODOR (O.). **Vectors of Mediterranean Kala Azar.** [Correspondence.]—*Nature.* 1932. Oct. 1. Vol. 130. No. 3283. p. 507.

The authors have previously shown that a large percentage of both *Phlebotomus perniciosus* and *P. major* become infected with leishmania after feeding on Chinese hamsters infected with *Leishmania infantum.* In the case of *P. perniciosus* it was also shown that if the infection extends forwards to the epipharynx flagellates will escape from the proboscis during feeding. It was further shown that visceral leishmaniasis in susceptible animals (*Cricetulus griseus* and *Citillus citillus*) resulted on inoculation into the skin of flagellates from *P. perniciosus.* For these and other reasons it was concluded that this sandfly was a vector of kala azar in the Mediterranean area. This sandfly cannot, however, account for the whole of the kala azar of this area, for in Greece in the neighbourhood of Argos, a heavy centre of infantile kala azar, and in Athens, where both the infantile and canine diseases occur, it was not found. On the other hand *P. major* was common. This sandfly, owing to its purely nocturnal activity, had been previously overlooked in Greece. *P. major* is rare in Malta but is common in a limited area near Catania in Sicily. In order therefore to make a comparison between *P. perniciosus* and *P. major* a naturally infected dog was taken from Malta to Catania, where both sandflies were fed on the animal. Of 31 *P. major* 25 became infected while of 119 *P. perniciosus* only 33 became infected. It thus appears that *P. major* is a better carrier of Mediterranean kala azar than *P. perniciosus.*

C. M. Wenyon.

ANDERSON (Charles). Nouvelle contribution à l'étude du problème du kala azar. Culture du virus en lait de chèvre. [**The K. A. Problem. Culture of Leishmania in Goat's Milk.**]—*Arch. Inst. Pasteur de Tunis.* 1932. Dec. Vol. 21. No. 2. pp. 294–297.

Of 53 cases of splenomegaly submitted to spleen puncture for the diagnosis of infantile kala azar 19 were positive and 34 negative. Of the positive cases it was found that goat's milk had formed a large part of the diet of 16 while of the negative cases it had only figured in the diet of possibly two. The apparent association of leishmania in the spleen with goat's milk led to the testing of this milk as a culture medium for the parasite. Milk was sterilized by exposing it to a temperature of 70°C. for 30 minutes on three occasions. Tubes of this undiluted milk were prepared, as also tubes of milk rendered alkaline with a solution of sodium carbonate. Furthermore milk was added in equal quantity to the water of condensation in tubes of N.N.N. medium. In all these media flagellates grew remarkably well, and in the pure milk showed a survival at 22°–24°C. of 4 months. It was also possible by inoculating a tube of the pure milk with bone marrow from an infected dog to obtain a culture of flagellates. Experiments are in progress to test the susceptibility of goats to kala azar and the possibility of their playing a part in the spread of the disease. *C. M. W.*

Franco (Enrico-Emilio). Les leishmanioses en Sardaigne. [**Leishmaniasis in Sardinia.**]—*Rev. Méd. et Hyg. Trop.* 1932. Sept.-Oct. Vol. 24. No. 5. pp. 217–242. With 1 fig. & 1 map. [2 pages of refs.]

The paper gives a general account of kala azar and oriental sore as observed in Sardinia up to the end of 1931. Twenty-four cases of kala azar have been described, six cases of oriental sore and one case of mucosal infection in which the only lesion was an ulcer on the left lower turbinal of the nose. Canine kala azar was first noticed in the island in 1917 by Sotgia but more recently Pegreffi has been studying 12 cases. *C. M. W.*

Phinos (Vassilios G.). Beitrag zur Diagnose der allgemeinen Leishmaniose (" Ponos," " Kala-Azar "). [**Diagnosis of K.A.**]—*Arch. f. Schiffs- u. Trop.-Hyg.* 1932. Nov. Vol. 36. No. 11. pp. 594–598. [15 refs.]

As early diagnosis is of the utmost importance in the treatment of kala azar the author has reviewed the various methods of diagnosis. Apart from the actual finding of parasites by one of the recognized methods, of which spleen puncture, not always free from danger, is the most certain, he appears to place the greatest reliance on the antimony test. For this he employs a 4 per cent. solution of neostibosan. Of 78 known cases of kala azar 71 gave a positive reaction while of 67 cured cases only one was positive. Of 309 controls only 13 were positive. It was positive also in the case of six children showing signs suggestive of kala azar who were brought to the clinic but did not return for spleen puncture. *C. M. W.*

Ruiz (Pedro Maximo). Un caso de kala-azar infantil diagnosticado parasitológicamente en sangre periférica. [**Cases of K.A. in Spain.**]—*Medicina Países Cálidos.* Madrid. 1932. Nov. Vol. 5. No. 6. pp. 486–506. With 5 figs. & 4 charts.

Cortés (Antonio Pedrajas). Información sobre un caso de kala azar infantil.—*Ibid.* pp. 510–511.

The first paper describes in great detail a case of kala azar in a child twenty months old from Cadiz. Diagnosis was made in the first place by the discovery of leishmania in a thick blood film of the peripheral blood. A cure was effected with neostibosan. The second paper records the first case of infantile kala azar from Maracena (? Granada). *C. M. W.*

Guasch (J.) & Llaurado (A). Un caso de infección asociada de kala-azar y paludismo en una enferma de dieciocho años. Un caso de kala azar en un enfermo de treinta años. [**Case of K.A. Associated with Malaria.**]—*Medicina Países Cálidos.* Madrid. 1932. Sept. Vol. 5. No. 5. pp. 424–428.

The two cases of kala azar, both in adults, were seen by the authors in Barcelona. The first was in a woman 18 years of age. In spite of treatment with neostibosan the temperature remained elevated. Repeated examinations failed to reveal any cause for this till after two months when the parasites of quartan malaria were discovered in the blood. Quinine treatment followed by treparsol brought about a

rapid response and uninterrupted recovery. A spleen puncture performed two days after the discovery of malarial parasites showed that the leishmania present two months before had quite disappeared. The second case was in a man 30 years of age. After diagnosis by spleen puncture had been made the patient left the country.

C. M. W.

CHATTERJEE (Krishnadhan). **Jaundice in Kala-Azar. (Van Den Bergh Reaction in Kala-Azar.)**—*Calcutta Med. Jl.* 1932. Nov. Vol. 27. No. 5. pp. 133–144. [11 refs.]

The author discusses the part played by the reticulo-endothelial system in blood formation and destruction and in the production of bile pigments. As the reticulo-endothelial system is blocked with parasites in kala azar there will be diminished blood formation and consequent anaemia, diminished bile pigment formation and little tendency to jaundice and diminished defence and immunity reaction rendering more serious the onset of such complications as cancrum oris and pneumonia. Naturally there cannot be excessive blood destruction in kala azar so that, contrary to the claims of GUHA (this *Bulletin*, Vol. 29, p. 870), the type of haemolytic jaundice giving a direct delayed van den Bergh reaction seen in malaria, pernicious anaemia, Bengal splenomegaly, ankylostomiasis, acholuric jaundice and other diseases is not met with. *C. M. W.*

PHINOS (Vassiliou). Die Behandlung von Kala-azar mit Neostibosan unter besonderer Berücksichtigung der Diagnosestellung mittels der Serumreaktion. [**Treatment of K.A. with Neostibosan.**]—*Arch. f. Schiffs- u. Trop.-Hyg.* 1932. Oct. Vol. 36. No. 10. pp. 515–521.

An account is given of the treatment of 10 cases of kala azar in children from 1 to 12 years of age by intramuscular injections of neostibosan. As a rule an injection was given each day, a total of 8 to 10 in each case. The total quantity given varied with the weight from 0·38 to 3·0 gm. Of the 10 patients 5 recovered while 4 died and one was taken away without having shown any improvement after having had 0·65 gm. in eight injections. One died of noma, one of pneumonia and one of tuberculosis. It is concluded that the treatment is to be recommended because of the ease of administration, the cures it brings about and the shortness of the course, which makes it inexpensive.

C. M. W.

ZAHRA-NEUMANN (Charles). **A Report on the Treatment of Infantile Kala-azar.**—*Trans. Roy. Soc. Trop. Med. & Hyg.* 1933. Jan. 31. Vol. 26. No. 4. pp. 383–388.

Between the end of March 1923 and the beginning of May 1932 there were treated in Malta 315 cases of infantile kala azar. The first 100 cases treated with tartar emetic gave a mortality rate of 26·5. That this was unnecessarily high is shown by the fact that with further experience the mortality rate with this drug in the next 124 cases was 17·7. Better results were subsequently obtained with neostibosan in 68

cases with a mortality of 10·17 per cent. One case, which appeared to resist tartar emetic treatment, responded to neostibosan while two cases resisting neostibosan were cured by tartar emetic. Certain cases failed to respond to either drug. It is noted that the quantity of neostibosan required to effect a cure contains three times as much antimony as the amount of tartar emetic so required. *C. M. W.*

Lignos (A.). Note sur le traitement du kala-azar infantile. [**Treatment of Infantile K.A.**]—*Bull. Soc. Path. Exot.* 1932. Dec. 14. Vol. 25. No. 10. pp. 1043–1044.

The author points out that during the 3 winters (November to April) of 1929 to 1932 there were diagnosed in the Isle of Hydra 35 cases of infantile kala azar. All but one of these children were treated by intramuscular or subcutaneous injections of stibenyl and were cured except two, one insufficiently treated while the other died of pneumonia. The dose at each injection as a rule varied from 6 centigrams to 12 centigrams as the age varied from 6 months to two years. Each child received 30 injections, one every third day. Though occasionally the above dosage was exceeded no unpleasant results were noted. At the present time all the children are alive and well. *C. M. W.*

Brahmachari (Upendranath), Majumder (Akhil Ranjan) & De (Rash Behari). **The Intensive Antimonial Treatment of Kala-Azar—Urea Stibamine. Part II.**—*Jl. Trop. Med. & Hyg.* 1933. Jan. 2. Vol. 36. No. 1. pp. 1–5.

The authors give details of the cure of 31 cases of kala azar by daily injections of urea stibamine. The number of injections varied from 4 to 16 and the total amount of drug from 0·2 to 2·5 gm. It is noted that with daily injections in 26 of the 31 cases 1·5 gm. or less of the drug was sufficient to bring about a cure, which is significantly less than the quantity which would be required by less intensive forms of treatment. [Though the cases are referred to as cured, the after history of a number of them does not extend beyond one month.] *C. M. W.*

Brahmachari (Upendranath). **Studies in Kala-Azar and Chemotherapy of Antimony. Part VI. Treatment of Kala-Azar with Intramuscular Injection of Sodium Sulphomethyl Stibanilate.**—*Trans. Roy. Soc. Trop. Med. & Hyg.* 1933. Jan. 31. Vol. 26. No. 4. pp. 389–396. With 14 charts.

The paper describes the successful use of sodium sulphomethyl stibanilate in the treatment of 15 cases of kala azar by intramuscular injection. It has been used up to a dose of 0·5 gm. without producing local or constitutional disturbance. *C. M. W.*

Micheletti (Ettore). Sul reperto di leishmanie libere nel sangue periferico. [**Free Leishmania in the Peripheral Blood.**]—*Ann. di Med. Nav. e Colon.* 1932. Sept.-Oct. 38th Year. Vol. 2. No. 3–4. pp. 564–570. With 5 figs. on 1 double plate. [16 refs.]

After reviewing the records of the discovery of leishmania in the peripheral blood of cases of kala azar the author gives an account of his

own findings in the case of a child 9 years of age. He discovered parasites in films of the peripheral blood but always extracellular. He puts aside the possibility that this position is the result of damage to cells in film making, for the parasites, singly or in groups, were not near leucocytes. This leads him to various speculations regarding the habitat and virulence of the parasites, all of which break down if it is thought possible that the parasites he observed had actually escaped from a large mononuclear cell which had been completely destroyed as often happens in making the films. *C. M. W.*

RAY (J. C.). **Cultivation of Various Leishmania Parasites on Solid Medium.**—*Indian Jl. Med. Res.* 1932. Oct. Vol. 20. No. 2. pp. 355–367. With 4 figs.

The author, who has studied the cultivation of leishmania in solid media during several years, has arrived at a technique which gives abundant growth of the organisms. The medium employed is a special form of agar to which as usual one-fifth of its volume of defibrinated rabbit blood is added. Directions are given for using this medium in Petri dishes, according to the technique of NÖLLER, or in ordinary test tubes on the sides of which small basins to hold the medium have been blown. Those who wish to repeat this work must consult the article for details of technique. *C. M. W.*

DA FONSECA (Flavio). **On Specific Agglutination with Noguchi's Technic as a Method of Distinction of Flagellates of the Genus *Leishmania* Ross, 1903.**—*Amer. Jl. Trop. Med.* 1932. Nov. Vol. 12. No. 6. pp. 453–457.

——. **Differentiation of Flagellates of the Genus *Leishmania* Ross, 1903, by the Lytic Action of Specific Sera.**—*Ibid.* 1933. Jan. Vol. 13. No. 1. pp. 113–126. [55 refs.]

In these two papers the author describes experiments he undertook to differentiate various leishmania from one another and from leptomonas of the flea by the use of the sera from rabbits which had been subjected to inoculations with the flagellates. The medium employed in the first series of experiments, described in the first paper, was Noguchi's leptospira medium in which the normal rabbit serum was replaced by immune rabbit sera, a large number of which had been prepared. The tubes after inoculation with the flagellates were left at room temperature and examined from time to time for evidence of agglutination. It was found that anti-*Leishmania brasiliensis* serum agglutinated all the 13 strains of *L. brasiliensis* which had not been lysed by the serum but none of the strains of *L. tropica*, *L. donovani*, *L. canis* or *Leptomonas ctenocephali*. In the second paper experiments to test the lytic action of the immune rabbit sera are described. In this case haemoglobin was added to the medium and the cultures were left for 10 days at a temperature of about 25°C. At the end of this time flagellates were only present in those tubes in which the sera were heterologous. All the strains of *L. brasiliensis* were lysed by *L. brasiliensis* sera but none of the other flagellates tested. The results indicate a close relationship between the 13 strains of *L. brasiliensis* isolated in Brazil and the Argentine and their difference from the other species investigated. *C. M. W.*

Falchetti (E.) & Brac (G. Faure). La leishmaniose canine à Nice. Etude épidémiologique. [**Canine Leishmaniasis at Nice.**]—*Bull. Soc. Path. Exot.* 1932. Dec. 14. Vol. 25. No. 10. pp. 1091–1099. [10 refs.]

During a period of 9 months the authors have examined for kala azar 188 stray dogs at the pound at Nice. The dogs were divided into two groups—those showing signs suggestive of kala azar and those showing none. In the first group there were 42 [? 43] dogs, of which 18 were found to be infected at post mortem examination. Of the second group of 145 dogs 19 were infected, showing that even when dogs appear healthy they may be suffering from kala azar. The authors also examined 19 other dogs still under the care of their owners and showing symptoms suggestive of the disease. Of these 15 were positive. The various procedures for diagnosis were tested. This included examination for parasites in scrapings from ulcers and in material from liver and bone-marrow puncture; culture of the puncture material; serological reactions such as the formol gel test, the antimony test or deviation of the complement. In 3 cases it is stated that parasites were only present in the ulcers but their absence from the internal organs was not determined by culture methods but merely by smear examinations. It is evident that no clinical sign is pathognomonic of kala azar in dogs and that no single test or examination will give a definite diagnosis. *C. M. W.*

Giraud (P.) & Cabassu (H.). La leishmaniose canine dans la région de Marseille. [**Canine Leishmaniasis in Marseilles District.**]—*Bull. Soc. Path. Exot.* 1932. Dec. 14. Vol. 25. No. 10. pp. 1040–1043.

During the study of 39 cases of canine kala azar seen in 3 months in the district of Marseilles the authors have noted three types of lesion which on scraping or incision will often yield leishmania. The first takes the form of ulcers on the inner surface of the lips, the second of ulcers about the eyes or ears and the third plaques of dermatitis on the face or back. Examination of these lesions is much simpler than puncture of the organs or bones and will often give a positive diagnosis. The formol-gel reaction is positive in advanced cases but is of little help at the commencement of the disease. *C. M. W.*

Falchetti (E.). Observations sur la localisation cutanée des *Leishmania* chez les chiens dans le midi de la France. [**Cutaneous Localization of Leishmania in Dogs in S. France.**]—*Bull. Soc. Path. Exot.* 1932. Dec. 14. Vol. 25. No. 10. pp. 1036–1039. With 2 figs.

The author during a study of canine kala azar in the South of France, particularly in Nice and Marseilles, has been able to confirm the observations of Adler and Theodor made in Malta that the parasites are distributed throughout the body in the skin where they are lodged in the histiocytes and even in fibroblasts. These infected cells occur not only round the hair follicles and sebaceous glands but also in the intervening areas. The follicles and glands are more heavily infected in areas of skin showing eczema. When actual ulceration occurs parasites are rare in the ulcerating area but increase in numbers as the more healthy skin is reached. As noted by Adler and Theodor there is no relation

between the number of cutaneous parasites and those in the internal organs. This is so marked that the author is inclined to the view that the primary site of infection is the skin and that it is here that the parasite finds conditions favourable to reproduction. *C. M. W.*

Balozet (L.). Les prélèvements pour la recherche des leishmanies ; technique de la ponction de la rate chez le chien. [**Technique of Skin Puncture and Allied Diagnostic Procedures in the Dog.**]—*Arch. Inst. Pasteur de Tunis.* 1932. Dec. Vol. 21. No. 2. pp. 341–346. With 1 fig.

In this article the author gives directions for the operations of bone puncture, liver puncture and spleen puncture for the diagnosis of kala azar in dogs. For the first of these the tibia is chosen and under local anaesthesia a small hole is made with a drill in the upper third of the tibia through its antero-internal surface. Through the hole bone marrow is aspirated with a syringe. Puncture of the liver is readily accomplished by passing the needle of the syringe in the tenth right intercostal space at a point one to two finger-breadths from the spinous processes of the vertebrae. In large animals the needle must be at least 6 cm. in length. Spleen puncture is more difficult to perform and is regarded by some as impossible. The author, however, has evolved a technique which has simplified the operation. With the animal in the recumbent position with its back uppermost the spleen lies just posterior to the left costal margin. An imaginary line drawn horizontally so as to divide the thorax into equal upper and lower parts when looked at from the side will cross the costal margin at a point on a level with the middle of the spleen. Puncture just posterior to this point will find the organ. It is evident that experience is required for this operation and readers are referred to the original article for further details and directions. *C. M. W.*

Coussa (Maurice). Contribution à l'étude et au traitement du bouton d'Alep. [**Study of Aleppo Sore.**]—*Gaz. hebd. Sci. Méd. de Bordeaux.* 1932. Sept. 25. Vol. 53. No. 39. pp. 615–624.

The author, who has had a large experience of oriental sore in Aleppo, having in two years dealt with 980 cases exhibiting 2,774 sores, analyses these cases from the points of view of distribution of sores on the body, seasonal incidence, susceptibility in relation to age, sex and nationality, and character, number and duration of the sores. As regards treatment the author advocates the use of the cryocautery especially where a single sore is present. When multiple sores occur antimony treatment is indicated, the drug favoured being fouadin, on account of the possibility of administering it subcutaneously.

C. M. W.

Mazza (Salvador). Nuevas observaciones sobre tratamiento de la leishmaniosis americana por la fuadina. [**Treatment of American Leishmaniasis by Fouadin.**]—*7a Reunión Soc. Argentina Patol. Regional del Norte, Tucumán, 5, 6 y 7 octubre, 1931.* 1a mitad. pp. 513–526. With 14 figs.

The author, who has already reported the good results he has secured in the treatment with fouadin of mucocutaneous leishmaniasis in the

Argentine (this *Bulletin*, Vol. 29, p. 117) now describes a series of 6 other cases. Three of these were in children aged 3, 5 and 11 years belonging to one family. It is of interest that they all contracted the disease simultaneously in a locality where the father and mother had previously suffered from the same condition. The fourth case was in a child 4 years of age and the fifth and sixth in adults of 35 and 18 years. Some of the patients had had previous treatment with drugs which had not influenced the infection. All were treated with intramuscular injections of fouadin in doses varying from 0·5 to 5·0 cc. The treatment was continued for varying periods, and in all cases, including the second with a mucosal lesion in the roof of the mouth, brought about a cure except in two, one of which, the child of 3, was on the way to recovery when death occurred from pneumonia. The other resistant case was the youth of 11 years of age. The lesion, which was a large one behind the ear, diminished considerably in extent but had not completely healed after 29 injections. Treatment was interrupted for two and a half months when not only did the original lesion show signs of renewed activity but a further one appeared on the outer surface of the forearm. Injections of fouadin were recommenced but did not have the desired effect. Accordingly treatment with intravenous injections of neostibosan was instituted. There was an immediate response and a rapid healing of both lesions. *C. M. W.*

Silva (Flaviano). Vantagens e inconvenientes do tratamento da leishmaniose tegumentar pelo eparseno (amino-arsenophenol). [**Treatment of Dermal Leishmaniasis by Eparseno.**]—*Brasil-Medico.* 1932. Sept. 10. Vol. 46. No. 37. pp. 785–788. With 2 figs.

In muco-cutaneous leishmaniasis of S. America eparseno brings about a rapid cicatrization of the lesions, even in those which have proved to be resistant to tartar emetic and other treatments. Contrary to the claims of many authors, however, the drug is fairly toxic so that it is not possible to continue the treatment for any length of time. It is evident that this drug has not completely solved the problem of treatment of this disease. *C. M. W.*

Donatien (A.), Lestoquard (F.) & Parrot (L.). Leishmaniose et fusospirochétose associées chez le chien. [**Leishmaniasis and Fusospirochaetosis Associated in the Dog.**]—*Arch. Inst. Pasteur d'Algérie.* 1932. June. Vol. 10. No. 2. p. 296. With 2 figs. on 1 plate.

The authors refer to two cases of cutaneous leishmaniasis described by Delamare and Gatti in which the sores had become secondarily infected with spirochaetes and fusiform bacilli. They record the history of a dog which was brought to the Pasteur Institute in Algiers suffering from kala azar with ulcerations about the nose, ears, paws and tail. The dog was kept under observation for a year during which time the ulcer on the nose assumed a crateriform character. Examination revealed few leishmania but numerous spirochaetes and fusiform bacilli which, it is concluded, had aggravated the lesion. *C. M. W.*

DI LOTTI (V. Kálalová). **An Experiment for Immunization against Cutaneous Leishmaniasis.**—*Ann. Trop. Med. & Parasit.* 1932. Dec. 16. Vol. 26. No. 4. pp. 545–550.

The author had the idea that immunity to oriental sore might be produced by grafting into the skin of a non-immune person a small portion of skin from one that had already had the disease. Accordingly in 12 cases the operation was performed, the piece of skin being removed from near the scar of a healed sore. Seven of the 12 cases were observed for 1 to 4 years. Though they all lived in districts of Baghdad where practically no one escapes, 4 remained free from infection. In the 3 that contracted the disease the grafted skin had been taken from persons who had recovered from 29 to 40 years before. In the other cases the scars were 1, 2, 5 and 6 years old respectively, so that the skin taken from persons in whom immunity was still developed, appeared to be capable of conferring immunity when grafted. *C. M. W.*

FRANCHINI (Giuseppe). Leishmaniosi nelle colonie italiane del Nord-Africa. [**Leishmaniasis in the Italian Colonies of N. Africa.**]—*Arch. Ital. Sci. Med. Colon.* 1932. Dec. 1. Vol. 13. No. 12. pp. 703–707. English summary (6 lines).

The author summarizes the records for human and canine kala azar and oriental sore from the Italian colonies of N. Africa. Up to the present very few cases have been noted. *C. M. W.*

MARCIALIS (Italo). Contributo alla conoscenza della leishmaniosi infantile in Sardegna. [**Infantile K.A. in Sardinia.**]—*Pediatria.* 1932. Dec. 1. Vol. 40. No. 23. pp. 1292–1299. [25 refs.]

Record of a case of kala azar in a child six years of age in Sardinia.

C. M. W.

LENFELD (J.). Contribution au diagnostic clinique de la leishmaniose canine spontanée. [**Clinical Diagnosis of Canine K.A.**]—*Rev. Gén. de Méd. Vét.* 1933. Jan. 15. Vol. 42. No. 493. pp. 1–11.

This paper is the French version of the first of three noted in this *Bulletin*, Vol. 28, p. 647. It is there pointed out that an examination of the smears and sections from the dog " Hongkong " by the reviewer himself, who had received them from the author, revealed no evidence of leishmania infection. *C. M. W.*

LAVILLAT (F.) & CATTOIR (E.). Un cas de bouton d'Orient dans le Tell constantinois. Traitement par le néostibosane. [**Oriental Sore in Algeria.**]—*Arch. Inst. Pasteur d'Algérie.* 1932. Sept. Vol. 10. No. 3. pp. 410–412.

PASCAL (J. M.) & BACHY (J.). Sur l'existence du bouton d'Orient au Mzab.—*Ibid.* pp. 413–415. With 3 figs. on 2 plates.

HORRENBERGER (R.). Existence du bouton d'Orient à Beni Ounif (Sud oranais).—*Ibid.* pp. 416–417.

The three papers record cases of oriental sore (one, three, and two cases respectively) from the localities in Algeria mentioned in the titles.

C. M. W.

SCHEWEBEL (A.) & FOURRIER (J.). Un cas autochtone de bouton d'orient dans la région de Bone.—*Arch. Inst. Pasteur d'Algérie.* 1932. Mar. Vol. 10. No. 1. p. 39.

REVIEWS AND NOTICES.

MATHESON (Robert) [Ph.D., Professor of Entomology, New York State College of Agriculture, Cornell University]. **Medical Entomology.** —pp. xiv+489. With frontispiece & 211 figs. 1932. London: Baillière, Tindall & Cox, 7-8 Henrietta Street, Covent Garden, W.C.2. [29s.]

Text books on Medical Entomology continue to arrive from the United States. The latest to appear is by R. Matheson, Ph.D., who is professor of entomology at the New York State College of Agriculture in Cornell University. This is a very well-balanced work which presents the established facts of medical entomology clearly and concisely. Indeed, the most striking feature of the book is the admirable sense of proportion displayed by the author in dealing with each side of his subject; anatomy, medical importance and control measures are clearly set forth. The work is generously illustrated and most of the figures are clear and well chosen; though it is to be doubted whether the line drawings of the various Muscid flies will really prove very helpful. Another good feature of the book is the way in which the reader's attention is directed continually to original publications, each chapter being followed by a considerable bibliography (in one of which the *Tropical Diseases Bulletin* is described as "the most valuable of publications"), while the first chapter gives an excellent historical account of medical entomology during the past fifty years.

From a general standpoint, American textbooks are apt to seem a trifle insular; and that under review is no exception. There is a key to the North American species of *Anopheles* and the breeding habits of these are discussed; but species from the rest of the world are mentioned only in lists, and no adequate impression is given of the diversity of conditions to be met with elsewhere. And this same fault appears also in the somewhat sketchy accounts of plague and sleeping sickness. *Aëdes variegatus* is included in a list of vectors of filariasis, but the significance of its diurnal habit in relation to filarial periodicity in the South Pacific is not mentioned. A number of keys to genera and species are included, and many of these will certainly prove useful; but it is difficult to see any value (except for purely instructional purposes) in incomplete keys such as that on page 40, which embraces just a few of the better known species of *Ornithodorus* selected more or less at random and unaccompanied by any warning to workers in the field not to use it. The book is well indexed and seems to be singularly free from minor errors—although the familiar figure on page 393 still bearing the legible signature of Terzi is credited to Sambon. The publishers' leaflet claims, among other things, that Professor Matheson's book "presents the cultural background." Perhaps this refers to many of the excellent features mentioned in this review; perhaps it refers to the fact that the book is prefaced by what can only be described as the world's worst couplet. *V. B. Wigglesworth.*

STANTON (A. T.) [C.M.G., M.D., F.R.C.P., Chief Medical Adviser to the Secretary of State for the Colonies; formerly Director of Government Laboratories, F.M.S.] & FLETCHER (William) [M.D., M.R.C.P., Member Colonial Advisory Medical Committee; formerly Director, Institute for Medical Research, F.M.S.]. **Melioidosis.** *Studies from the Institute for Medical Research, Federated Malay States, No. 21.*—pp. iv+59. With 3 charts & 37 figs. on 27 plates. 1932. London: John Bale, Sons & Danielsson, Ltd. [Review appears also in *Bulletin of Hygiene.*]

In this short monograph is collected the available information, much of which is due directly to the work of the authors themselves, on that interesting and rather puzzling disease, melioidosis. First described by

Colonel WHITMORE at Rangoon in 1912, the disease has since been recognized in the Federated Malay States, in Cochin-China, Tonking, and Ceylon. Of a total of 83 cases reported up to the present time all but three have occurred in males and all but two have proved fatal. Melioidosis appears to be a natural disease of rodents, especially rats, but its incidence in these animals is not known precisely. Infection of human beings is supposed to occur as a rule through consumption of food contaminated with infected animal excreta. The authors are of the opinion that the disease is far commoner than would appear from the number of reported cases; considering that only nine cases have been diagnosed during life, this seems highly probable. So little is yet known about its frequency, about the method of spread, and about the occurrence of non-fatal and possibly latent infections, that workers, especially in the tropics, should be actively on the look-out for this disease. The present volume with its brief, clear description of the clinical and pathological manifestations both in man and animals, its account of the causative organism, and its discussion on diagnostic procedure, should assist in this enquiry, and should be read by all tropical workers who are not already acquainted with the original papers of the authors. *G. S. Wilson.*

SCHNITZER (R.). **Die spezifische Arzneifestigkeit der pathogenen Mikroorganismen.** [The Specific Drug Resistance of the Pathogenic Microorganisms.] Reprinted from *Ergebnisse d. Hyg. Bakt. Immunitätsforschung u. Experim. Therap.* 1932. Vol. 13. pp. 227–326. With 1 text fig. [5 pages of refs.]

It is now just over 25 years since EHRLICH founded the subject of chemotherapy. Almost at the beginning of his work EHRLICH (and his co-workers BROWNING, FRANKE and ROEHL) discovered the important fact that trypanosomal infections in mice were capable of gradually developing a resistance to parafuchsin; and shortly afterwards it was ascertained that these infections could likewise be made resistant to aromatic arsenicals, such as atoxyl, and to the acridine dyes. The practical significance of this discovery for the treatment of trypanosomal infections of man and stock was at once realized by EHRLICH, and probably since that time no aspect of the subject of chemotherapy has attracted more attention than has drug-resistance. Whilst much experimental work has been done, and many more or less unsatisfactory clinical observations have been made, there is no doubt that theory has far outstripped facts, and the whole subject has become chaotic. The literature dealing with drug-resistance of microorganisms is now enormous: and nobody who troubles himself to wade through it can fail to be impressed with the many contradictory statements which it contains, with the many unwarrantable deductions which have been made solely on the basis of analogy, and finally with the gigantic superstructure of hypothesis which has been erected on the shifting sands of questionable experimental facts.

In the present article, consisting of about 100 pages, Schnitzer has presented a masterly summary of the investigations which have hitherto been made on the subject of drug-resistance. Such an article could only have been written by one who has devoted himself many years to experimental research on the subject, and there can be no doubt it is an excellent piece of work, which will prove invaluable to all who, in the future, may enter this fascinating, but very difficult, field of work.

It is with trypanosomal infections that by far the greatest amount of work on drug-resistance has been done, and consequently the bulk of the present article is concerned with these infections. Nevertheless, the author deals fully with what has been done on the other protozoal infections (malaria, amoebiasis), on the spirochaetal infections, and on the various bacterial infections. It would be very advantageous if those clinicians who write and talk so glibly about quinine resistant malarial parasites, emetine resistant amoebae, salvarsan and mercury resistant spirochaetes,

and so forth, would refer to this article so that they might discover how little is really known on these matters. Such a piece of research might cause them to pause and ask themselves how far actual observation is responsible for the faith that is within them, and whether they have not, in large measure, been carried away by a natural, but very dangerous tendency, to draw analogies from what they know, or believe they know, happens in trypanosomal infections. It seems to the reviewer that such reflections might even assist the clinician to conceive it possible that there may be some other explanation of his failure to cure than that the parasite (trypanosome, malaria, amoeba or spirochaete) with which his patient is infected has become drug-fast. *W. Yorke.*

Logie (H. B.) [M.D., C.M. Executive Secretary] [Edited by]. **A Standard Classified Nomenclature of Disease. Compiled by the National Conference on Nomenclature of Disease.**—pp. xvii+702. 1933. New York: The Commonwealth Fund. [£1 1s. 0d.]

There has not hitherto existed in America any generally recognized standard nomenclature of disease such as is supplied in this country by the official Nomenclature of Diseases drawn up by the Royal College of Physicians. The present book is an attempt to provide such a standard. It has been compiled under the auspices of a National Conference on Nomenclature of Disease on which all the leading American Medical Organisations (including the American Society of Tropical Medicine) were represented. It is designed, in the words of the Preface, " to include every disease which can be recognised clinically, to avoid repetition and overlapping, and to classify the diseases in a logical manner." The system of classification is both topographical and etiological, each disease or injury being described and classified in terms of the tissue or organ where it is principally manifested as well as in etiological terms. It is thus much more ambitious than the official nomenclature of this country which provides only a list of approved names of diseases arranged under systems and organs. Whether the time is yet ripe for any complete classification of diseases on an etiological basis is a matter of opinion, and it may be objected that any attempt at such is bound to give the appearance of more accurate knowledge than we in fact possess. There can be no question, however, about the care and thought which have been bestowed on this particular classification and it will doubtless be found useful in America and elsewhere pending the issue of what is the ideal—an *international* Nomenclature on the lines of the " International List of the Causes of Death." In this country, however, and throughout the British Empire, the Nomenclature of Diseases must continue to form the basis of all official records for the present.

It should be added that, in addition to a classified list of diseases, the American Standard Nomenclature provides a system of code numbers affixed to the name of each disease which are designed to facilitate filing in hospitals and institutions as well as the collection of the elaborate tables and statistics which are so familiar in American medical literature. They seem well and ingeniously adapted to these purposes.

Robert Hutchison.

Rockefeller Foundation. **Annual Report 1931** [Mason (Max), President].—pp. viii+420. With numerous illustrations. New York: 61 Broadway.

This volume contains, besides the reports of the Secretary and Treasurer which are mainly financial, reports of the work of the International Health Division, of that in the Medical Sciences, that in the Natural Sciences, in the Social Sciences, and in the Humanities. Since readers of this *Bulletin* are chiefly interested in the work of the International Health Division we shall not refer again to the other sections.

In a brief review of the Public Health Program it is stated—Two general purposes have underlain the many forms of public health work in which the Foundation has participated: the acquirement of new knowledge in hygiene and public health by field and laboratory research; and the extension of such knowledge through application of what is already known. The Foundation undertakes such activities as would be pioneering in spirit, sound in principle and practical in purpose.

During 1931 the Foundation assisted the governments of 47 countries in carrying on public health work, continued contributions to the Health Organization of the League of Nations, and engaged in activities in connexion with tuberculosis, respiratory diseases, undulant fever and anaemia. It engaged in intensive field research on hookworm disease, malaria, and yellow fever. There follows an account of the work of the Foundation researchers on the last three. Yellow fever is studied at the Foundation laboratories in Nigeria, Bahia and New York. The papers briefly summarized were noticed in this *Bulletin* at the time of their publication.

Under Public Health Nursing and Nursing Education we learn that 1931 witnessed the conclusion of a ten-year period of co-operation between the Foundation and the Government of Brazil in the development of modern nursing, especially public health nursing and nurses' education. A training school was organized and Brazil now has a Bureau of Nursing which is part of the National Department of Health. In the D. Anna Nery School of Nursing the bureau has a first-class training centre with facilities for 100 students and a course of three years duration. The school has graduated 114 Brazilian nurses of whom 98 have remained in active nursing work. Similar activities were in being in other countries. In 1931 the Foundation assisted the governments of 33 foreign countries to develop and strengthen certain essential services, such as sanitary engineering, public health laboratory services, epidemiological divisions, bureaux of vital statistics. In sanitary engineering, for instance, help was given in Central America, Greece, China, Mysore, Egypt; in public health laboratories in Dublin, Nicaragua, Bogota, Sofia, China.

Under Public Health Education, Training Centres, we learn that funds were voted to assist the Government of Nigeria for a 3-year period in a program of public health development, which includes the establishment of centres for the training of African midwives, public health nurses and sanitary inspectors. In 1931, 226 health officials and health workers were enabled to visit countries other than their own. In the last ten years more than a thousand selected young men who had already completed their medical work were given opportunity to specialize in public health: these men go back to their own countries assuming key positions in the public health service.

Such are some of the enterprises of the International Health Division, valuable at any time but especially so in these days of financial stress when funds are almost everywhere lacking for fresh development. The report is attractively got up with many photographs, including one of Wickliffe Rose who died in the year under review and whose efforts in the campaign for eradication of hookworm disease in many parts of the British Empire from 1913 onwards will be gratefully remembered. *A. G. B.*

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